ARMY ORDNANCE

VOL. XIII, No. 76 JANUARY-FEBRUARY, 1933

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Newton D. Baker

The Use of the Machine in Battle
General Douglas MacArthur

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Artillery in the Classical Age
Major General J. F. C. Fuller

International Debts and Territory
An Editorial

A BIMONTHLY REVIEW OF AMERICAN MUNITIONS
PUBLISHED BY THE ARMY ORDNANCE ASSOCIATION, WASHINGTON, D. C.

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ARMY ORDNANCE

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Founded 1920

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

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"Certain patriotic citizens have realized the importance of adequate industrial preparation and have voluntarily organized to assist in this work. The Army Ordnance Association comprises such a group, upon which the War Department leans heavily in carrying on the many activities incident to this type of preparation."

Frederick H. Payne, The Assistant Secretary of War.

The Army Ordnance Association

THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our nation's strongest guarantee of peace.

The Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

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ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the nation's strongest guarantees of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect cooperation with American scientists, inventors, engineers and manufacturers in civil life and the regular and reserve officers of the Ordnance Department.

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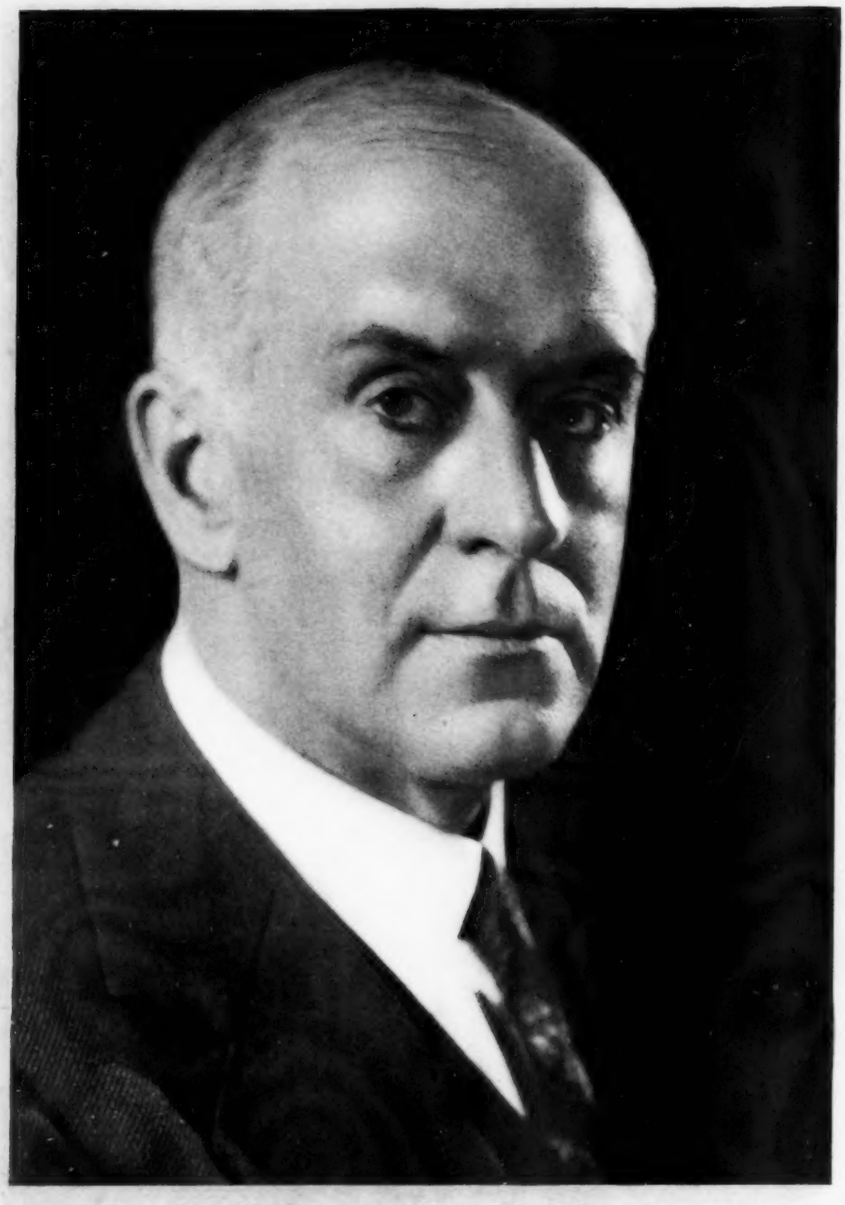

Lieut. Col Winthrop Withington, Ord. Res., U. S. Army

Recently Appointed Chief of the Cleveland Ordnance District

ARMY ORDNANCE

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Ordnance Reminiscences

The High Purpose of the American Effort for Peace

By Newton D. Baker*

GENTLEMEN of the Army Ordnance Association and Fellow Citizens: Although I have had the courtesy of many invitations from this Association, a coincidence makes this the first opportunity I have had to accept one. I am most grateful to you for the invitation and most happy to be here.

When I look back to the occasion which created the bonds which hold this Society together the first thought that springs into my mind is "boosters and adapters." Although the Ordnance Department was triumphantly successful in every part of its great war task, there seemed to be some peculiar difficulty about boosters and adapters. They were the pinch point in the Ordnance program. I now venture to suggest that, if the secret of boosters and adapters has been finally discovered, the present situation of the country makes it peculiarly important that the secret be disclosed generally. Perhaps a few boosters and adapters may get us over the pinch point of the depression!

Those in this audience who have been at all aware of my small doings since the war will realize that one of the passions of my life has been to advance the cause of international peace, and as I have had occasion to speak on that subject in other places it has been a matter of profound gratification to me to be able to say some things which would remove erroneous impressions on the subject of the causes of war. The first of these is that the history of the United States, when scrutinized, fails to disclose a single war in which our country was engaged that had been in any degree fomented, pressed or urged by officers of the American Army.

The second of these is that when our country has gone to war through the inability of our statesmen to keep the peace the American soldier has accepted the task of the country's defense with splendid zeal, and has given himself to that task with complete and unselfish devotion.

THE notion that professional soldiers are persons who desire war in order that they may have the opportunity to advance in their profession is erroneous, and I have been gratified at opportunities to try to correct it. Similarly, the suggestion that members of the National Guard and other military organizations, through a spirit of adventure, have desired war is a common error. The fact is that wars have come to us not at all because of the spirit of adventure on the part of regular or other soldiers; they have come from the nature of man and the kind of civilization which man has built up in the course of the years. When we reflect upon it we realize that nature itself uses force to accomplish its purposes, and the earliest lesson man learned from nature was to accomplish his purposes by the use of force upon those who obstructed him.

As progress has gone on we have realized—both civilians and soldiers—that war is an expensive way to accomplish even a high national purpose, that the issues of modern civilization are too precious to be submitted to the determination of armed forces, and that under conditions as they now are the direct and incidental cost and consequences of war make it imperative for the world to find some other way to work out conflicts of national interest and aspiration.

In order that there may be some other way it is necessary for us to discipline our desires by our imagination. When we were children we eagerly desired harmful things, and our parents disciplined our desires by telling us of the harm the things would do us if we did secure them. As individuals we acquired this sort of discipline through experience; hence if the world is to be peaceful there must be set up among us constructive agencies disseminating information, creating tolerance and sympathy and infusing the foresight of imaginative minds into those unimaginative people who do not see the consequences of immediate resort to force to accomplish, it may be, a very temporary and transient purpose.

Throughout the years since the war I have received innumerable plans from various peace societies and individuals who seemed to feel that if the world would adopt their plan war would be a thing of the past. Very likely any plan, if universally adopted, would succeed, but the trouble is to get any substantial number of people really and heartily to adopt the same plan. When you are dealing with the human race, and have in mind its history and experience, the "if" in any of these plans becomes the controlling factor in it, for only patience and education will produce agreement. The forces which make for war in the modern world are intricate combinations of economic aspiration, pride, and fear. Before they can be combatted they must be understood, and if we are all agreed that force in the settlement of international controversies is too costly to be endured we must be similarly agreed that general education, which will teach people sympathy and tolerance and enable them to make just valuations of national objectives, is the process by which the preservation of peace must be sought.

I AM not here to talk about the war, but rather for a moment to indulge with you in priceless memories. Whether we are to have other wars or not, we did have one war which brought us together, and no one in this room can look back upon that experience without feeling his pulse go faster, not because it was a war, but because it was a time of great spiritual exaltation and adventure when every man wanted to do his all for a perfectly unselfish cause.

*Secretary of War 1916-1921. This is an address delivered at the Fourteenth Annual Meeting of the Army Ordnance Association, held at the Union League Club, New York, December 21, 1932.

The hours seemed long as we now look back on them. On many occasions I did not leave the War Department until long after midnight, and my tasks were relatively simple by comparison with many of those who bore the exacting burdens of detailed preparation. So far as I am personally concerned I seem to have served two principal purposes in the Department during the war. One was that I lent my shoulder for others to weep on, and became the confidant, and I hope the consoler, of those whose burdens were too heavy. The second was to drive out of the War Department offices those who wanted to work twenty-six hours a day instead of sixteen. I remember when I tried to persuade General Crozier to go home one morning at about two o'clock. His comment was: "Why, Mr. Secretary, you're not gone yet, so why should I go?"

But those hours, long as they now seem, then seemed far too short for the performances to which we were devoting ourselves. The coöperation was magnificent. Regular Army officers in your group welcomed into the War Department civilians as technical advisers with a perfection of mutual understanding between civilians and the Army which has seldom existed before. No party of officers of the Ordnance Department wasted time on questions of rank and precedence. The usual requirement of Washington dinners which places ranking officers above the salt disappeared in the stress of those days. Friendships and understandings grew up between professional soldiers and civilians, the Army realizing that the civilians were intelligent and helpful aids, and the civilians learning that, while the Army wore the uniform of their country as the badge of their profession, they wore the flag of their country around their hearts, as the embodiment of their motives. I still feel as young as I did in those days, and those whose faces I recognize in this company seem to me not to have changed, and I think we will not change to each other, for the thing in each of us which the others delight to remember is the common and high purposes which we shared when we thus worked side by side.

A MOMENT ago I was trying to illustrate that in dealing with mankind it is necessary to recall the lessons of history which teach us what a recalcitrant thing human nature is. We have to deal with men as they are. A conversation I once had with General Gorgas gives a playful and delightful illustration of this point. He came into my office one day, looking very much disturbed, and when I inquired the cause of his distress he said: "I have lost every friend in the medical profession in America. When we started in the war I called on every expert surgeon in the nation and asked them to send me their understudies. When they came I made them colonels and majors. As the need became greater I again called on them to send me their next assistants, and I made them captains and first lieutenants. At last it became necessary to send for the surgeons themselves, and now all the great surgeons of the country are here, and I have nothing left to make them but second lieutenants and sergeants!"

I tried to console him by observing that I thought the distinctions he was making in rank were important only to military men, while surgeons would not care whether they were captains or generals, to which he replied: "Ah, Mr. Secretary, you little understand human nature if you entertain such an idea as that. Human beings are quite unaccountable. You never can tell what men will do. Some men seem to fret and become troubled over the small things of life, and you expect very little of them, but in a great emergency they will rise up and surprise you with their ability, while other men who seem to deal easily with the usual affairs of life, and from whom you expect a great deal, flatten out completely under an emergency test.

"Take me for an example," he said. "When my wife and I were to be married we had been sweethearts for a long time, and our families and all our friends joined in giving us dances and parties. The day before the wedding we had a rehearsal and everything went off beautifully, but when I stood up before the minister and he solemnly said to me: 'William, do you take this woman for your lawful wife, to love and to cherish, for richer or poorer, in sickness or in health, until death do you part?'—do you know, I looked him stupidly in the face and said: 'Repeat that question, please.'"

I treasure the memory of that great gentleman, the Chief Surgeon of the Army. I treasure the memory of your great Chiefs of Ordnance. I treasure the memory of all those who shared with me those heavy responsibilities and of those who went overseas, who were the objects of such deep concern and solicitude to all of us.

May I add only one other thought. Every now and then some civilian, writing about the war, fixes the day when the War Department began to move. It was such and such a day, and from then on America was efficient. Of course, the fact is that the serious work began when the war began. Those long months of planning and contriving had to precede production, and what the civilian sees as a sudden burst of success on the part of the War Department in the middle of our war activity was merely the fruit of those early days when men like Colonel Scott, who receives your medal tonight, laid the solid foundation of later production.

The fact that I am privileged to be present when you confer these medals adds to the honor of my being here at all. I trust that you will always keep this Society together, and that even though you may not be called upon again to use the experience and the knowledge which you learned in the war you will at least be brought together on these annual occasions to keep and refresh the lasting friendships you have made.

The Use of the Machine in Battle

The Powers and Limitations of Mechanized Equipment

By General Douglas MacArthur*

THE Editor of ARMY ORDNANCE has asked my permission to republish from my annual report to the Secretary of War that section devoted to mechanization. Not only am I pleased to grant the request but I can not let the opportunity pass without extending a word of congratulation to the engineers, executives and manufacturers who are members of the Army Ordnance Association for their devotion to the progress of industrial preparedness. The mechanization of armies is an important question as well to the possible producer of weapons as to the tactical user.

What I have written in the following pages could not have been written at all were it not for the fact that American industry by its own research and resources, and in coöperation with the technical services of our Army, has made possible the engineering advances in the mechanical equipment of peace which are having a vital influence on the future conduct of war.

In recent years probably no other subject has so engaged the attention of military students as has that of adapting the peculiar capabilities of the motor-propelled vehicle to the requirements of battle. In this country and in all foreign armies the possibilities of increasing fighting strength and conserving man power through a maximum utilization of machines continue to be assiduously explored.

The inclusion in military units of motor-driven vehicles purely as transportation for troops and supplies is known as "motorization," while their employment on the battlefield as actual weapons is termed "mechanization."

During the past fiscal year visible progress in the Army toward mechanization consisted in the procurement of seven combat vehicles of the "Christie" combination wheel and track type at a cost of $262,000 and 12 armored cars of the most modern design at an approximate cost of $190,000. In addition, the Tank School and Tank Board, previously located at Fort Geo. G. Meade, Md., were transferred to and combined with the Infantry School at Fort Benning, Ga. Because of the unusual facilities for experimentation, test and study offered at the Infantry School, it is confidently expected that progress in the development of tactics and equipment suitable for infantry missions will be facilitated. A Cavalry center for similar purposes was established at Fort Knox, Ky.

Viewed solely from the standpoint of acquisition of mechanized equipment, these accomplishments appear inconsequential when compared to our probable total requirements in a major mobilization. By way of contrast it is interesting to note that when the armistice was signed the United States Government had made arrangements for the production of 19,000 tanks to be used in the 1919 campaign.

BECAUSE of the peculiar and far-reaching nature of the general problem involved, however, progress in its solution can not be measured by any such simple process. In explanation of the present War Department policies governing this important matter and of our present state of preparedness with respect to it, I shall review briefly the conditions that gave birth to the tank idea and the progress we have made in adapting that idea to our own needs.

The fire power of modern weapons is so great that when they are properly located in strongly held defensive positions exposed men can not live in the zones lying within their effective ranges. This organized fire, based principally upon interlacing fires of machine guns and supported by artillery, is the principal obstacle to movement on the battlefield; and until disrupted or smothered is capable of stopping all direct and unarmored assaults upon the defensive position.

Up to and including the first years of the World War almost the only method applied to the disorganization of defensive fires was the concentration by the attacker of superior artillery strength. So long as the ranges and capabilities of small arms were such as to compel the defense to adopt a substantially linear formation, this method met with a sufficient degree of success to induce attacking forces to seek superiority through the perfection of its detail. But with every increase in the efficiency of firearms, defending forces were enabled to distribute their formations in greater depth and still bring the fire of all units to bear upon the vital zone in front of the main position. The artillery bombardment thus had increasingly larger areas to cover, while the defender could make a maximum use of accidents of terrain and of artificial cover to protect himself. Moreover, the movement into position by the attacker of the great amount of material necessary to produce the effect desired generally apprised the enemy of the imminence of decisive action. With the element of surprise removed, the defense was enabled to concentrate whatever reserves he had available so as to limit any initial advantage gained by the attacking army. Assaults, even when locally successful, became almost prohibitively expensive in men, material and time.

Finally, the problem became of such difficult proportions that when the absence of flanks on the western fronts had limited all offensive movement in that theater to frontal attack and the bombardment method had failed to produce real results, military men were forced to recognize the existence of a practical stalemate under the conditions and methods then prevailing.

In the desperate search for some weapon that could help restore a superiority of power in favor of the attack, the central powers resorted to the use of chemicals, a method that was substantially countered by protective equipment and by retaliation. The Allies brought forward the motor-propelled armored vehicle, capable of cross-country travel. Mobile armor, after a lapse of centuries, had made its reappearance on the battlefield because a means had finally been found of transporting over varied terrain a protective shield capable of stopping the bullets then in use. This development, however, was a slow and laborious one because of the intricate technical nature of the necessary equipment. From the day the tank made its appearaance on the western front as a clumsy, awkward, mechanically unreliable, and painfully slow

*Chief of Staff, U. S. Army.

armored vehicle, the attention of technical experts in all armies has been devoted to the development of a completely suitable combat machine.

AS a measurable degree of success attended these efforts, there was inevitably suggested the possibility of employing such weapons in other kinds of tactical enterprise. The attainment of victory imposes upon an army the necessity for undertaking a variety of activities which may be grouped into several rather well-defined categories. It must conduct efficient reconnaissance and counter-reconnaissance from the outset of the campaign; move swiftly in the directions indicated as desirable; concentrate its personnel and matériel at the critical point or points; hold firmly all areas vital to its own success; strike with the maximum power of fire and shock; and exploit rapidly and fearlessly every advantage gained. Each of the several arms has been organized, equipped, and trained for the purpose of carrying out a particular part or parts of the whole task. In all categories of activity the two principal material characteristics contributing to the success of military units are speed in movement and power in action. To enhance these is the constant effort of responsible authorities in every arm of the service.

In the field of reconnaissance the airplane has entered the battle team with an unquestioned ability to perform many of the missions that before the World War fell exclusively upon the cavalry, and many additional ones that previously could not be performed at all. In supplying long-range information regarding the general dispositions of the enemy, its services are now indispensable. Moreover, under reasonably favorable conditions, it can continue its reconnaissance over all portions of the hostile areas throughout the duration of the campaign, even during battles, and furnish the ground arms with a variety of important information obtainable in no other way.

While the air force, in addition to its many other tactical and strategical uses, has thus relieved the cavalry of some of its former responsibilities, it can not give to ground forces undisputed possession of the area lying toward the enemy in which the maneuvering of the Army must take place. A highly mobile ground force of some fighting power is still necessary for this purpose and to cover the slower moving main army. This has always been a responsibility of the cavalry, utilizing the horse as a means of rapid transportation and often as a shock weapon in actual assaults. In the latter rôle the modern bullet has driven the horse from the battlefield, and in the former his relative degree of usefulness is gradually diminishing. But the traditional cavalry missions of covering the advance or retreat of the main army, of conducting terrestrial reconnaissance, and of exploiting victory by pursuing a disorganized army remain unchanged. Cavalry interest in mechanization has therefore been centered principally in armored cars and cross-country vehicles possessing a high degree of strategic mobility, with fighting power and tactical mobility an important though secondary consideration.

TO date we have been able to set aside only one unit of Cavalry for exclusive use as a laboratory in which to develop applicable tactics and methods and test the machines made available. To attempt more in the present state of development would entail useless expense without compensating advantage. The evolution of the mounted trooper into the mechanized cavalryman will necessarily take place over a considerable period of time, and will become practically complete only when machines have been developed capable of performing every function heretofore devolving upon the horse, and these machines will have been made available in adequate quantities. This, for reasons I will explain later, can not be accomplished suddenly. In the meantime the Cavalry must still depend upon mounted units in carrying out certain of its missions, particularly during the early stages of any war, or in terrain unsuited to the operation of existing motor vehicles. Thus, while we may safely predict that the horse will more and more be eliminated from armies, it is equally certain that under present conditions some mounted units must be kept available for use in emergency.

The activities of the Infantry in this development have naturally followed more closely the original conception under which the tank made its appearance on the western front in 1915. Upon this arm has always fallen the brunt of the task of dislodging the enemy from defensive positions. The ideal machine for assistance in this mission must of necessity have a high degree of tactical mobility, even at the expense of reducing, if necessary, road or strategic mobility. Remembering that the greatest obstacle to tactical mobility is the band of fire laid down by the defense, an essential requisite in the assaulting tank is sufficient armor to protect against the preponderant mass of this fire, namely, that from all types of small arms. More than this is impractical, at least at present because every increase in armor means a corresponding loss in speed and cross-country ability. Sufficiently heavy armor to protect from field guns would completely immobilize any machine of usable size. For protection of this kind the tank must rely upon rapid movement, surprise, proper use of ground, and the supporting guns of its own army.

The Artillery also has made much progress in substituting machines for animals as motive power, and the early motorization of practically all field artillery can be predicted. Because of the nature of the artillery mission and equipment, however, this arm has not been so concerned in the development of protective armor for its personnel. Its problem in this matter is principally one of mobility, whereas the search for satisfactory combat vehicles has had in every case to steer its way between the requirements of armored security on the one hand and speed and cross-country ability on the other.

IN considering the extent to which the theory of mechanization can be practically applied, it is necessary to recall some of the obvious limitations of the motor-driven armored vehicle. One of these is its inability to negotiate certain types of terrain. Swamps, mountains, thick woods, streams, and extremely rough ground are in general effective obstacles to its use. In such areas, if important from a military viewpoint, the Infantry, Cavalry, and Artillery must operate without the assistance of mechanized units.

Another important factor is the lack of sustained defensive power in a machine, whether armored or not. When stationary in exposed positions, they are easy prey to artillery fire, and their usefulness in battle is limited to situations demanding their continuous movement. For the defense of a position, units capable of making a maximum use of the ground for shelter, and of delivering an overpowering concentration of fire against assaulting elements, are essential. In other words, as long as there is necessity in warfare of taking, occupying, and defending positions or areas, troops having capabilities similar to those of Infantry and Artillery are indispensable elements in an army. Even here nothing

static in training, equipment, and organization is implied. If the attack is to be supported by strong mechanized units, inevitably development in infantry equipment must be toward inclusion of greater numbers of weapons capable of disabling the tank. This will entail parallel changes in organization, training, and transportation methods.

As would naturally be expected in a development of such recent origin, all models of combat vehicles so far produced tend to become obsolete as a result of continued progress in this branch of the mechanical sciences. The best tank of the World War is now hopelessly antiquated, and it is safe to predict that the best of today will be considered of small relative value a few years hence. Eventually a greater degree of stabilization will probably apply, and the effective life of each model will be substantially greater. Under present conditions, however, any attempt to maintain large units equipped with the latest and most efficient models of combat vehicles would entail the replacement of great amounts of equipment every few years. Manifestly the expense of such a procedure would be enormous.

Another factor complicating the problem of tank design is the continuous progress in producing bullets of extraordinary armor-piercing qualities. There has recently been developed a very high-velocity bullet (5,800 foot-seconds) which gives promise of ability to pierce at will any armor now carried on tanks and other fighting vehicles. If this development should prove capable of general application in all types of small arms, tank design and possibly even the whole theory of mechanization will necessarily undergo revolutionary changes.

In view of these considerations present progress toward mechanization must consist principally in the production of the best in pilot models; making precise prearrangements for speeding up their production in emergency; procuring annually sufficient numbers for thorough tactical test and for developing tactical doctrine of mechanized units; and indoctrinating the whole Army in methods of coöperation so as to capitalize fully the inherent capabilities of these machines and make allowances for their inherent weaknesses.

Our actual experience in the development of pilot models has been on the whole encouraging, though not without its bitter disappointments.

Immediately following the close of the World War the using services, then principally the Infantry, had much difficulty in settling upon the performance characteristics desired in a suitable Infantry tank. The influence of World War experience was still strong, and there was visualized a necessity for a group of machines of great size and power, as well as for numbers of smaller ones. Much study and discussion finally resulted in the production of two so-called medium tanks (22 tons) produced by the Ordnance Department. The hope was that this type would constitute an all-purpose Infantry tank, combining the essential characteristics of both the "heavy" and "light" tanks employed during the World War. There was also procured the first model of the Christie tank, a type featuring a convertible track and wheel chassis.

Until 1927 these were the only tanks of postwar design actually procured by the War Department, and their cost was extremely high because of the experimental nature of the project. During this period, however, the ideas of the using service reached a more definite focus, and attention was turned to the production of speedier vehicles of lesser tonnage.

Each experiment furnished valuable lessons, and succeeding models have gradually approached the necessary type.

The first machine that gave sufficient promise to warrant more extended test than was possible in a pilot model was known as the T1E1. In 1928, 6 of these were procured, 4 of which were fighting vehicles and 2 cargo carriers. While infinitely better than the war-time models, they still fell short of what appeared to be minimum requirements, particularly in speed.

On the other hand, the Christie models, although invariably speedy, were generally most unreliable mechanically. Because of its speed this particular tank, probably more than any other, was responsible for awakening the Cavalry to the possibility of supplanting the horse in some of its units with fighting machines. Mechanical defects were partially overcome, and eventually it was determined to procure a reasonable quantity for thorough test. As I have already stated, seven of these were acquired during the past fiscal year and are being tested by both the Infantry and the Cavalry. Preliminary reports indicate that mechanical defects are still such as to bar the adoption of these machines as standard equipment, but hope exists that improved models may yet prove satisfactory. Current appropriations provide for the procurement of five additional machines of the convertible wheel and track type.

In armored cars our development has been more satisfactory, the engineering problems involved being generally less difficult of solution. Since 1928, 23 of these have been procured, the latest model, of which we now have 12, giving every indication of its suitability. Eight others are in process of procurement, and a greatly improved 4-wheel-drive type is being secured from commercial sources.

The total cost since 1920 of our experiments and procurements in fighting vehicles has been approximately $2,000,000. The results attained are not to be measured in the small number of modern machines now on hand, but principally in the tremendous progress we have made toward the production of a satisfactory pilot model.

It is obvious that for some years to come, at least, there can not possibly be available in the initial stages of any great emergency large units completely equipped with the most modern types of fighting vehicles. But the Army's mission requires its readiness for defense under conditions of the moment. It must be prepared to utilize existing means at the same time that it strives to develop more efficient means to accomplish the defeat of the enemy. Far-reaching changes, such as that implied in mechanization, are subject to many delays, errors, setbacks, and discouragements. Commanders and staffs must, therefore, visualize early operations in which only a very few mechanized units will be on hand, and develop methods that will be effective in spite of this shortage, at the same time that tactics are evolved for the employment of machines when they have become available in quantity.

THIS brings up the important question of providing for the speediest possible production by commercial concerns of tanks and other types of armored vehicles in emergency. The prearrangements involved are intricate in nature. They can not be pushed to ultimate completion until such time as various experimental types have reached a stage justifying their adoption as standard by the Army, and exact manufacturing specifications are prepared. Thereafter plans will necessarily be revised continuously to conform to changing conditions in industry and to further improvements in approved types. In spite of difficulties definite progress in this direction has

been realized. The supply branches, working under the supervision of the Assistant Secretary of War, are making every practicable preparation. As a result it is now possible to predict that, in any emergency involving a major mobilization, tanks will reach quantity production in approximately 12 months. While this estimate may eventually be somewhat reduced, it is certain that an appreciable length of time will always be required for the conversion of manufacturing plants from peace-time activity to production of this character.

Exactly what effect progress in mechanization will have upon the number of men necessarily mobilized in a major emergency no person can possibly yet foretell. We know that the airplane and the tank of the World War necessitated the establishment of large supply, maintenance and repair organizations in their rear, and the ratio of required personnel to operating machines was extremely large. Complicated weapons and machinery, when applied to the battlefield, have tended to require a more highly trained personnel and the employment of more rather than fewer men.

ALLIED to the subject of mechanization is that of general munitions development and improvement. In this work the same broad policies are observed as those I have heretofore described as applying to the training and organizational phases of military preparation. Under our system no effort is made to be prepared instantaneously for a major war. Rather, the aim is to accomplish in peace, and as economically as possible, all those preliminary tasks and investigations which will facilitate in emergency the efficient mobilization, training, and equipping of a citizen soldiery. In weapons and equipment we strive to foresee probable war needs, both as to type and quantity, and make necessary arrangements for prompt satisfaction of those needs. Experimentation, test, approval as to type, procurement of moderate quantities for training of personnel, and arrangements for emergency production are the sequential steps in every such program.

One of the most extraordinary recent advances in new equipment has been the production of a heavy bombing airplane of vastly increased efficiency. It represents the greatest single development of the past decade in performance characteristics of this type of plane. Capable of carrying 2,000 pounds of bombs and a crew of four men, it has a maximum speed of about 165 miles per hour and a cruising radius of some 500 miles. The significance of this achievement can be well appreciated when it is recalled that only two or three years ago a 100-mile cruising speed and a radius of action of 250 miles were considered satisfactory in heavy bombing planes. A few of these remarkable ships were secured during the year for service tests, and more are now on order.

Improvements in antiaircraft fire-control instruments and guns have continued. The speed and accuracy with which antiaircraft fire can now be delivered are little short of amazing, and our pilot models in this type of equipment are at least the equal of any others now existing. There is real need, however, for funds to purchase reasonable quantities with which to arm existing units. While in certain types of weapons we are justified in postponing quantity production until after the beginning of any emergency, in airplanes and antiaircraft matériel we should, for obvious reasons, always have on hand moderate amounts for immediate defense, in the event of war, of vital industrial and population centers.

During the past year much effort has been centered on the semiautomatic shoulder arm. Tests have demonstrated the efficiency of the latest model produced, known as the Garand. Attention is now being directed toward a redesign of the gun to permit the employment of the standard caliber of ammunition used in our Army. There is every reason to believe that this effort will be attended with complete success, and a number of these guns have been ordered for service test.

In the aggregate there are hundreds of items in which our technical experts are developing models, the most efficient of their kind. These items vary in character from the delicate radio instruments for communication between fast-moving combat vehicles to heavy seacoast guns for harbor defense.

The Army's intense interest in these projects is not occasioned by a belief that any machine or weapon in itself is or can be the dominant factor in war. That factor is man himself. It is men who declare war, and it is men who must uphold on the battlefield the decision the nation has made. Armed conflict, which occurs when all other means of adjusting vital international differences have failed, continues until the determination of one contestant to carry on the struggle has been overcome.

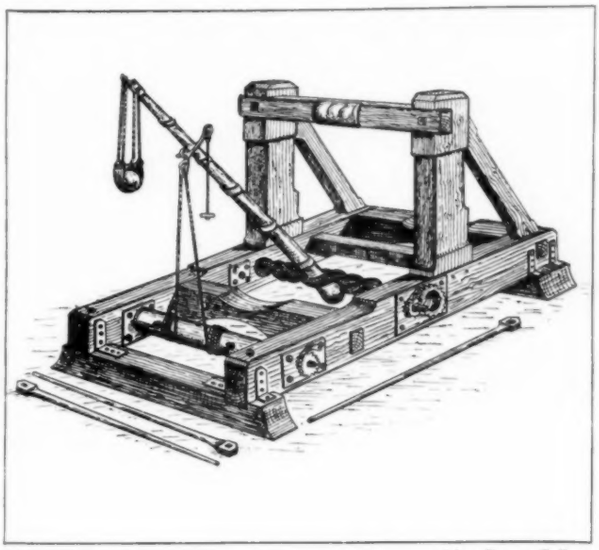
The power that men exert in battle may be represented as the algebraic sum of a variety of elements, among which are leadership, numerical strength, morale, organization, mobility, logistic arrangements, individual skill and training, and the quality and quantity of weapons and equipment. Before engaging in decisive action each side makes every effort to be stronger in all these elements than is the other. If either opponent enjoys overwhelming superiority in any one of them and approximate equality in all the others, it will almost certainly be successful. Thus a tremendous and even decisive superiority may accrue to an army if its enemy has failed to recognize and to exploit the advantages offered by scientific achievements. It is, therefore, one of the fundamental responsibilities of peace-time military establishments to develop the utmost efficiency in weapons and equipment as well as in all other elements that go to make up combat power. While the most effective equipment does not necessarily make the most effective army, properly employed it enhances the power of an army to serve the State by which that army is maintained.

Artillery in the Classical Age

Its Significance to Mechanization in the Twentieth Century

By Maj. Gen. J. F. C. Fuller*

THE study of the evolution of weapons during the Classical Age which, for convenience sake, if for no other reason, may be considered to have opened with the siege of Troy, in 1100 B.C., and to have closed with that of Rome in 410 A.D., is not one of purely historical interest, for in itself it constitutes an abbreviated edition of the development of modern weapons during the fifteen hundred years which followed the fall ot the Western Roman Empire. In each of these two periods three tactical cycles may be discovered, which for brevity's sake I will call the shock, shock and projectile and projectile cycles. In the first, the sword, pike, or lance, predominated, and in countries where the horse was bred, these arms were better wielded by cavalry. In the second, we find a division of these weapons between cavalry and infantry, the infantry using them to clinch with, whilst the mounted troops charged or maneuvered round the locked masses of foot. During this period projectile-throwing weapons, such as bow and sling, began to creep in, and normally grew in numbers until the third cycle began to uncoil itself when projectile weapons were divided into two main categories: those which could be used by the individual soldier, and those which required a team of men to work them. The first category includes the bow, cross-bow, musket and rifle; and the second, the catapult, ballista, trebuchet, cannon and machine gun. Eventually the heavier missile throwers are divided into field and siege pieces. All these developments we see in one form or another during the Classical Age, and again during the present Christian Age, the tendency in weapon evolution being to avoid the hand-to-hand fight, and in place to attack and destroy an enemy when at a distance from him.



After Payne-Gallwey

The Catapult.

The shock period which was once as common in naval warfare as it was recently so in land warfare, has now been out-grown at sea, and all but out-grown on land; battles, naval or military, being won by projectiles and projectiles alone. On land the two main missiles are the bullet and the shell, and in recent years the rifle bullet has been largely ousted by the machine gun bullet, and the machine gun *is not a true hand weapon,* but a piece of artillery. It may be carried by one man, but it requires a team of men to keep it supplied in battle, and so do all volume fire weapons however light.

This evolution from *arme blanche* to small and large projectiles can clearly be traced during the Classical Age, though there is not the same continuity of development as there is in the Christian Age, because the former covers the history of the rise and fall of several separate empires; whilst European nations, from the time of the Crusades, in which most of the western kingdoms fought side by side against a common adversary, though frequently at logger-heads amongst themselves, have been bound together by a common religion and culture.

Hand projectile throwers I do not intend to deal with in this paper; but the bow was in all probability the earliest engine of war devised by man, the sling and blow-pipe being of later date. In any case we know that the bow was used in the south of France and in Cantabria by the prehistoric hunter-artists in the tenth millennium B.C., and that in the East from the earliest times it was a common weapon of war. The idea of a more powerful weapon, especially in siege work, when it was necessary to out-range the hand bow, in order to cover by fire the approach of scaling and assaulting parties, probably arose in the East during the ninth or eighth century B.C. In the Bible we read that Uzziah, who reigned from 808 to 756 B.C., "made in Jerusalem engines invented by cunning men, to be in the towers and upon the bulwarks, to shoot arrows and great stones withal" (1); and by Ezekiel we are told that, against Tyre, Nebuchadnezzar was destined to "set engines of war" against its walls(2). This siege took place at the opening of the sixth century B.C.

OF these engines there were throughout the Classical Age two main types, the catapult and the ballista, or in modern terms the howitzer and the field gun; the first being used for high and the second for low angle fire. In both cases the force of propulsion was generated by tightly twisted skeins of rope, hair, or sinew, prepared in a manner now unknown, for though in recent years many replicas of both these engines have been made, the problem of maintaining the elasticity of the sinews has remained unsolved. The ballista was shaped like a cross-bow each arm being inserted

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in a twisted skein, and drawn back by means of a cord. The most complete account of the catapult(3) is given by the historian Amianus Marcellinus (4th century A.D.) who writes: "In the middle of the ropes (twisted skein) rises a wooden arm like a chariot pole . . . to the top of the arm hangs a sling . . . when battle is commenced a round stone is set in the sling . . . four soldiers on each side of the engine wind the arm down till it is almost level with the ground . . . when the arm is set free it springs up and hurls forth from its sling the stone, which is certain to crush whatever it strikes. This engine was formerly called a 'scorpion,' because it has its sling erect, but later ages have given it the name of 'Onager,' or wild ass, for when wild asses are chased they kick the stones behind them."

The sling added considerably to the range which varied from 400 to 800 yards, Josephus (37-100 A.D.) gives a maximum of 400 yards for a shot weighing a talent, that is approximately 58 lbs. The projectiles were of various kinds, such as large arrows, small metal balls, stone balls, and pebbles coated in baked clay which, shattering on impact, prevented the enemy using them in his own machines. Vitruvius (1st century B.C.) speaks of ballistae throwing stones of 2, 4, 6, 10, 20 and 360 lbs., and Plutarch in his life of "Marcellus" mentions one projectile weighing ten talents or nearly 580 lbs.(4).

The origins of artillery among the Greeks must be sought in Sicily, due probably to contact with the Carthaginians. About the year 400 B.C., Dionysius, tyrant of Syracuse, organized an expedition against these people. Of this expedition, which took place in 397 B.C., Diodorus writes: "For this purpose a great multitude of all sorts of workmen were brought together, to every one of whom he ordered their proper work, according to their several trades. . . . The art of making engines to hurl great stones was now first known at Syracuse, for at this time the most excellent artificers were met together from all parts: for the great wages . . . made the tradesmen and artificers very intent and industrious. . . . The artificers, thus encouraged, wrought with all diligence, striving to outvie one another, so that there were made a vast number of strange weapons and warlike engines for battery." And again: "He prepared, likewise, engines of battery of all fashions, and a vast number of darts"(5).

In this campaign we read: "The Syracusans . . . from the land killed great numbers of the enemy, by their sharp arrows, shot out of their engines of battery," and again "Dionysius . . . applied all sorts of engines of battery to the walls, battering the towers with the rams, and driving the defendants from the bulwarks with the shot from the engines. He approached likewise to the walls with six-floored towers, which moved upon wheels, and were as high as any house"(6).

From Syracuse the war engine was introduced into Greece, at what date is uncertain, but when the Spartan Archidamus, who reigned from 360 to 338 B.C., was shown the dart from a machine of war which had recently been brought from Sicily, he exclaimed: "O Hercules, the valour of man is at an end," a cry which has heralded the introduction of nearly every new weapon.

Philip of Macedon, who reigned between the years 360-336 B.C., was, however, an exceptionally broad-minded soldier, who at once recognized the value of the catapult and ballista in siege works. At the sieges of Byzantium and Perinthus, in 340 B.C., he made extensive use of his artillery. At the second of these two fortresses, unassailable by sea, for it stood on a promontory terminating in abrupt cliffs on the one side and protected by a high wall on the other, he assembled an army of 30,000 men, "and a vast multitude of darts and engines, both for battery and other purposes, so that the beseiged were very sorely pressed. . . . By his shot he forced the besieged from their bulwarks," but to no purpose, for, being reinforced from Byzantium, they beat back the Macedonian attack. Then Diodorus says: "In the meantime, while they were thus eagerly contending on both sides, Philip being well furnished with shot, mightily galled them upon the walls. But the Perinthians, though they lost many men every day, were reinforced with supplies of men, darts, and shot, from Byzantium; so that thereby becoming of equal force with the enemy, they took courage, valiantly stood to it for the preservation of their country"(7). Such was probably the first artillery duel which ever took place in Grecian history.

SIEGE artillery was then as today heavy and cumbersome, and being unsuited to mobile warfare it is almost certain that, recognizing its enormous advantage against the close order formations then in vogue, Philip organized true field batteries equipped with much lighter pieces, for we find his son Alexander the Great (356-323 B.C.) making use of such weapons in his earliest campaigns. Having crossed a river during his attack on Clitus and Glaucias, Arrian tells us that "he saw the enemy pressing upon the men in the rear," whereupon "he stationed his engines of war upon the bank, and ordered the engineers to shoot from them as far forward as possible all sorts of projectiles which are usually shot from military engines. He directed his archers, also, to enter the water, and shoot their arrows from the middle of the river. But Glaucias durst not advance within range of the missiles; so that the Macedonians passed over in such safety, that not one of them lost his life in the retreat"(8).

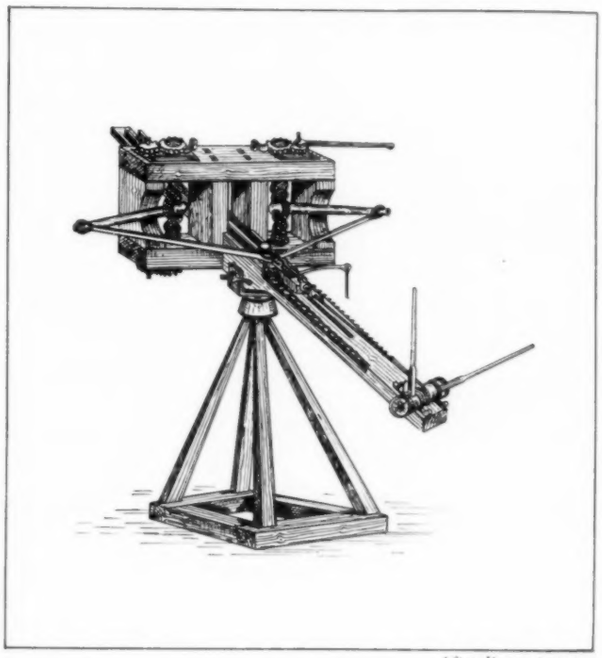
A still more interesting use of field artillery, again in a river operation, is to be found in his campaign against the Scythians. The enemy were on the right bank of the Oxus, and Alexander was determined to cross. "When the skins had been prepared for the passage," writes Arrian, "and the army fully equipped, had been posted near the river, the military engines, at the signal began to shoot at the Scythians riding along the river's bank. Some of them were wounded by the missiles, and one was struck right through the wicker-shield and breast-plate and fell from his horse. The others, being alarmed at the discharge of missiles from so great a distance, and at the death of their champion, retreated a little from the bank"(9). Alexander and his army then crossed.

As a besieger of cities and fortresses no general in antiquity rivalled Alexander, for in no single siege was he unsuccessful, and the siege of Tyre is certainly one of the most remarkable in history. Yet all his genius would have been unavailing had not he inherited from his father a highly organized siege-train. In all probability the heavier parts of the machines, rams, catapults, etc., were not carried in the field, but were manufactured when required; all tackle, gears, levers and sinews being transported in carts or upon pack animals.

At the siege of Tyre the war engines were not only used from the mole which Alexander built to connect the mainland with the island, but also from his ships. Arrian in-

forms us: "He also ordered those of his Triremes which contained the missiles to be hurled from engines, or which were carrying archers upon deck, to sail right round the wall and to run aground, so that the Tyrians, being shot at from all quarters, might become distracted, and not know whither to turn in his distress"(10). Thus did he cover by fire his final assault on the island fortress.

ALEXANDER conquered the world of his day, but it was his successors, the Diadochi, who revolutionized it. The enormous hoards of gold seized by Alexander in his conquest of Persia were squandered in civil war but they were by no means lost, for in a little over a generation after the death of the great Macedonian the western half of his empire came under the control of three great dynasties, the Antigonids in Greece, the Seleucidae in Syria and the Ptolemians in Egypt, and with them came into being a rich commercial and highly industralized civilization known as the Hellenistic period of history. As civil life changed so did the nature of war, and though the records of this epoch are imperfect, we see a steady increase in the use of projectiles until battles became markedly modern in nature.



After Payne-Gallwey

The Ballista.

The most remarkable soldier of this period, as far as war engines are concerned, was undoubtedly Demetrius Poliorcetes, son of Alexander's general Antigonus. His most famous exploit was the siege of Rhodes, where, in the year 304 B.C., he landed an army 40,000 strong assisted by no less than 30,000 artificers and workmen to construct his rolling towers, his rams and his war engines. His largest tower he called "Helepolis" in every story of which "were made loop-holes, proportionable, and in shape, to the nature of the artillery that was thence to be discharged. To these were shutters fastened to the engine, to draw up, for the better defence of them within that threw the darts; for they were lined with skins stuffed with wool, to deaden the force of the stone shot"(11). To move this veritable fortress required the united energy of 3,400 men, and behind it 1000 men worked a ram 180 feet long which was slung in the tower. The working of the ram was covered by the catapults and ballistae within the machine; some of the stone shot fired weighing 168 lbs.

In my opinion, however, it was as a naval architect that Demetrius excelled. In place of ramming his enemy's war ships, he cleared their decks by true broadsides of missiles. Diodorus writes:

"Demetrius being furnished with plenty of all things necessary for the making of engines, began to make two, called Testudoes, the one against the engines that cast stones, and the other against those that shot darts and arrows; these they placed upon the fore-decks of two transport-ships, which moved from place to place . . . he likewise made two towers four stories high each . . . both which likewise were placed upon two ships of equal height, and joined one to another. . . . He built likewise a rampart upon a four-footed piece of timber nailed together, to float upon the water, in order to beat off the enemy in any attack they might make upon the ships where the engines were placed. At the same time . . . he got together a number of the strongest water-boats, and fenced them round with boards and planks, and made loop-holes in the sides, (to shut at pleasure), and in these he placed engines to shoot darts and arrows of three spans long at a great distance"(12).

To beat him back, the Rhodians "mounted two engines upon a rampart, and put on board three others upon two transport-ships, and lay with them at the mouth of the little harbor; and in these they put great numbers of engines for the shooting of stones, darts and arrows, of all sizes, that by the help of these they might repulse the enemy, if he either attempted to land men, or make up with his engines. Besides all this, they had contrived convenient places and apartments in the transport-ships . . . wherein to place their engines and darts, as they had occasion"(13).

Yet in spite of all his engineering skill, Demetrius failed to take Rhodes, the land artillery baffling him as much as the valour of the Rhodians.

FROM now we enter the epoch of the great Hellenistic cities, highly commercialized and industrialized like Alexandria, which became the London, or New York, of its day. There gold-power was transformed into brain-power, and as these were warring times, armies became largely mechanized, and though valour is still an essential, muscle is supplemented by machinery.

The genius of Demetrius, as an inventor of war machines undoubtedly stimulated others to become more ingenious still, and many of these are not soldiers but civil engineers, mathematicians and mechanicians sitting in the quietude of the great Museum and the court-yards of Alexandria designing and testing-out new engines of war. In the hundred years which followed the death of Alexander the progress in mechanics was enormous, and we still have accounts of the engines invented by Heron (284-221 B.C.), Philo (about 200 B.C.) and Agesistratus (about 200 B.C.) who tells us that the artillery of his day could fire missiles up to a range of 800 yards. Dionysius, an Alexandrian, invented a "polybolos," or machine gun, which enabled a succession of arrows to be fired from a magazine(14). And Ctesibius, another engineer of this same city, discovered a means of gearing to

the bow arms of catapults pistons working in "carefully wrought cylinders" which were filled with compressed air(15). At the battle of Mantinea, 207 B.C., Machanidas, the tyrant of Sparta advanced with a large number of "carts carrying quantities of field artillery and bolts for the catapults"(16), but Philopoemen, the Achaean general, seeing that the enemy's plan was "by pouring volleys from the catapults into his phalanx, to throw the ranks into confusion," brought forward his light cavalry and charged the engines.

In the Hellenistic world we now enter a period of military decadence, and it has often been asserted by writers both civil and military that the general introduction of artillery caused a deterioration in the art of war. At most this is but a half-truth which may lead the student to a dangerous conclusion, namely, that improvement in weapons, and more particularly in the range of projectile weapons, destroys the offensive spirit of the troops equipped with them. This is a dangerous heresy. I have already recorded what the Spartan Archidamus thought of the catapult, and practically every new weapon invented has been met by the exclamation "O Hercules!" Monro, in 1626, anathematized "the invention of cannon," because they slew at a distance "men of valour . . . who before were wont to fight valiantly and long with the sword and lance, more for the honour of victory, than for any desire of shedding of blood." William Napier, in the nineteenth century, objected to the Minié bullet, because "it would turn infantry into long range assassins," and in the last war, the tank was objected to by more than one, because it was thought that infantry would learn to rely on it in place of upon their rifles.

As far as projectile weapons are concerned, there are however two possible reasons for decadence. The first is that they encumbered an army and reduced its mobility; this remained an unsolved problem until the introduction of the petrol engine. The second is that generalship did not keep pace with tactical inventions. The tactics of a cut and thrust army are very different from those of a projectile-throwing one. Decadence can be traced directly to this cause, for the generalship which took no notice of inventions, and which attempted to use men against machines in the same way as they used them before their adoption, destroyed valor through stupidity. It may be possible, because so many generals of this period did not understand the influence of the new weapons on tactics and morale, that a decadence set in, but surely not because these weapons were more powerful than the older ones.

AS in all probability the catapult and the ballista were introduced to the Greek by their colonists in Syracuse, so is it also probable that the Romans obtained their knowledge of these weapons from this same source, and more particularly when Marcellus set siege to Syracuse in the year 214 B.C.

This siege was rendered famous by Archimedes, the greatest mathematician and engineer of his age, whose amazing work is described by Livy(17), Polybius(18) and Plutarch(19). Polybius rightly says: "In certain circumstances, the genius of one man is more effective than any numbers whatever," and he quotes a saying from Euripides: "One wise man's skill is worth a world in arms." The most dramatic account is however given by Plutarch and this I will quote:

Heiro II, king of Syracuse, a relative of Archimedes, was so interested in his mechanical inventions that he begged him to employ his genius in designing engines suitable for siege warfare. This he did, and shortly after this king's death he made full use of them during the two years' siege of the city. "And in truth," writes Plutarch, "all the rest of the Syracusans were no more than the body in the batteries of Archimedes, whilst he was the informing soul. All other weapons lay idle and unemployed, his were the only offensive and defensive arms of the city."

The arrival of the besieging fleet and army struck terror into the citizens, but "Archimedes soon began to play his engines upon the Romans and their ships, and shot against them stones of such an enormous size and with so incredible a noise and velocity that nothing could stand before them. The stones overturned and crushed whatever came in their way, and spread terrible disorder through the Roman ranks. As for the machine which Marcellus brought upon several galleys fastened together, called 'sambuca'(20) for its resemblance to the musical instrument of that name; whilst it was yet at a considerable distance, Archimedes discharged at it a stone of ten talents' weight and, after that, a second stone, and then a third one, all of which striking it with an amazing noise and force completely shattered it"(21).

"Marcellus in distress drew off his galleys as fast as possible, and sent orders to his land forces to retire likewise. He then called a council of war, in which it was resolved to come close up to the walls of the city the next morning before daybreak, for they argued that the engines of Archimedes, being very powerful and designed to act at a long distance, would discharge their projectiles high over their heads. But for this Archimedes had been prepared, for he had engines at his disposal which were constructed to shoot at all ranges. When, therefore, the Romans came close to the walls, undiscovered as they thought, they were assailed with showers of darts, besides huge pieces of rock which fell as it were perpendicularly upon their heads, for the engines played upon them from every quarter.

"This obliged the Romans to retire, and when they were some way from the town, Archimedes used his longer machines upon them as they retreated, which made terrible havoc among them as well as greatly damaged their shipping. Marcellus, however, derided his engineers and said, 'Why do we not leave off contending with this geometrical Briareus(22), who sitting at ease and acting as if in jest has shamefully baffled our assaults, and in striking us with such a multitude of bolts at once exceeds even the hundred-handed giant of fable?'

"At length the Romans were so terrified that, if they saw but a rope or a beam projecting over the walls of Syracuse, they cried out that Archimedes was levelling some machine at them and turned their backs and fled."

Unable to take the city by assault, it was blockaded and finally taken by surprise. Archimedes was slain, much to the sorrow of Marcellus.

THAT the Carthaginians made considerable use of projectile-throwing machines is well known. In 149 B.C., when the Romans demanded the disarming of the citizens of Carthage they forced the surrender of "two hundred thousand stands of arms and two thousand catapults"(23), that would be ten to every one thousand foot or horse soldiers. Strabo gives the following account:

"For at the commencement of this war, they possessed

300 cities in Africa, and the population of Carthage amounted to 700,000 inhabitants. After being besieged and compelled to surrender, they delivered up 200,000 complete suits of armor and 300 engines for throwing projectiles, apparently with the intention of abandoning all hostilities; but having resolved to recommence the war, they at once began to manufacture arms, and daily deposited in store 140 finished shields, 300 swords, 500 lances, and 1000 projectiles for the engines, for the use of which the women servants contributed their hair"(24).

When New Carthage was captured in 146 B.C., Livy informs us that "An immense quantity of military stores was also taken; one hundred and twenty catapults of the larger size, two hundred and eighty-one of the smaller; twenty-three ballistae of the larger size, fifty-two of the smaller; an immense number of scorpions of the larger and smaller size, and also of arms and missile weapons; and seventy-four military standards"(25).

Sixty-three years later, when Sulla invested the Piraeus he made use of an immense siege-train. "Besides other equipage," writes Plutarch, "the very work about the engines of battery was supplied with no less than ten thousand yoke of mules, employed daily in that service. And when timber grew scarce, for many of the works failed, some crushed to pieces by their own weight, others taking fire by the continual play of the enemy, he had recourse to the sacred groves, and cut down the trees of the Academy, the shadiest of all the suburbs, and the Lyceum"(26).

Still progress in mechanization went on just as it had done with the Greeks after the death of Alexander. During the siege of Avaricum, in 53 B.C., Julius Caesar, apparently made use of some form of quick-firing engine, for in his "Bello Gallico" he writes: "A certain Gaul, before the gate of the town, was hurling into the fire, over against a turret, lumps of grease and pitch that were handed to him. He was pierced by a dart from a scorpion in the right side and fell dead. One of the party next him stepped over his prostrate body and went on with the same work; and when this second man had been killed in the same fashion by a scorpion-shot, a third succeeded, and to the third a fourth; and that spot was not left bare of defenders until . . . a stop had been put to the fighting"(27).

IN his campaign against the Bellovaci, in 51 B.C., we find Caesar using veritable bombardments of projectiles in the open field. Having built a bridge over a morass, he "led his army across, and soon reached the plain on the top of the hill, which was fortified on either side by a steep ascent." From this position: "Having there drawn up his army in order of battle, he marched to the furthest hill, from which he could with his engines, shower darts upon the thickest of the enemy"(28). We read of a similar operation when he attempted to hem in Pompey at Dyrrachium; for his ninth legion having gained a hill began to fortify it, whereupon Pompey seized a neighboring hill and brought such concentrated artillery fire to bear on these men that they had to abandon the work and withdraw(29). This is probably the first known instance of projectile weapons being used to prevent the construction of field fortifications.

Antony, we know, in his expedition against the Parthians, had a seige-train of three hundred wagons(30), the smaller field pieces were transported in carriages called "carrobalistae," some of which may be seen among the sculptures on Trajan's Column erected in Rome between the years 105-113 A.D. This field artillery was probably in use a hundred years earlier. These vehicles were harnessed to mules, and the pieces carried on them could be discharged over the heads of these animals. According to Vegetius(31), every cohort was equipped with one catapult and every century with one "carrobalista," eleven soldiers being required to work this engine. Consequently, a legion possessed an artillery train of 60 "carrobalistae" and 10 catapults, that is 60 field guns and 10 howitzers, in all 70 engines. This corresponds closely to the number of guns in a modern infantry division; but as the legion was seldom more than 6000 strong, frequently less, whilst in a modern infantry division the number of guns to infantry is about six per thousand, in the legion it was approximately double this number.

The importance of artillery from the days of Julius Caesar onwards cannot be exaggerated. In his Gallic Wars he made constant use of it, and the barbarians had none, a point which should not be forgotten. In the Civil War, again and again, are we shown the growing importance of projectiles. At Massilia "so great a store of everything necessary for a war had been a long time before laid up in the town, and so great a number of engines, that no vineae (mantlets, also called 'porticus') made of hurdles could withstand their force. For poles twelve feet in length pointed with iron, and these too shot from very large engines, sank into the ground through four rows of hurdles. Therefore the arches of the 'vineae' were covered over with beams a foot thick, fastened together, and under this the materials of the 'agger' (materials for a rampart) were handed from one to another. Before this was carried a 'testudo' sixty feet long, for (? after) levelling the ground, made also of very strong timber, and covered over with everything that was capable of protecting it against the fire and stones thrown by the enemy. But the greatness of the works, the height of the wall and towers, and the multitude of engines retarded the progress of our works"(32).

AGAIN in the battle fought near Cremona, in 69 A.D., is the importance of artillery again accentuated, this time by Tacitus who says: "Vespasian's army was giving way, when Antonius brought the praetorian cohorts to its support. Taking upon themselves the brunt of the action, they routed the enemy, and in their turn were forced to retreat: for the Vitellians had conveyed their engines to the high road, that their missiles might be discharged without obstruction or impediment, whereas at first they were scattered at random, and struck the shrubs without harming the enemy. The fifteenth legion had a ballista of enormous size, which, by discharging massive stones, was demolishing the opposing line, and would have dealt destruction far and wide, if two soldiers had not signalized themselves by a brave exploit. Covering themselves with the shields of the enemy, which they found among the slain, they advanced undiscovered, and cut off the ropes and weights. They both instantly fell, covered with wounds, and therefore their names are lost"(33).

During the reign of this emperor Roman artillery reached its zenith, and though extensively used until the sixth century, for during the siege of Rome, in 537 A.D., Procopius informs us that he saw a Gothic chieftain in armor transfixed to a tree by a ballista bolt, skill in making the machines

deteriorated. In the sieges of Jerusalem and Jotapata, in 70 A.D., and 67 A.D., respectively, Vespasian made much use of siege artillery, as we are told by Josephus. At Jerusalem—

"The engines that all the legions had ready prepared for them were admirably contrived; but still more extraordinary ones belonged to the tenth legion: those that threw darts and those that threw stones were more forcible and larger than the rest by which they not only repelled the excursions of the Jews but drove those away who were upon the walls also. Now the stones that were cast were of the weight of a talent, and were carried two or more stades. (Two stades = 404 yards.)

"The blow they gave was no way to be sustained, not only by those who stood first in the way but those who were beyond them for a great distance.

"As for the Jews, they at first watched the coming of the stone, for it was of a white color and could therefore not only be perceived by the great noise it made, but could be seen also before it came by its brightness; accordingly the watchmen that sat upon the towers gave notice when an engine was let go . . . so those that were in its way stood off and threw themselves down upon the ground. But the Romans contrived how to prevent this by blacking the stone; they could then aim with success when the stone was not discerned beforehand, as it had been previously"(34).

In the siege of Jotapata, Josephus who was present as a commander, says:

"Vespasian then set his engines for throwing stones and darts round about the city; the number of the engines was in all a hundred and sixty. . . . At the same time such engines as were intended for that purpose threw their spears buzzing forth, and stones of the weight of a talent were thrown by the engines that were prepared for doing so" (35).

I DO not intend to carry on the history of Roman artillery beyond this point. Its decadence was due both to loss of skill in manufacture and to the defensive policy of the later Roman Empire. That the Roman armies deteriorated is true, but this was the result of policy and social decay rather than because of increased weapon power. It is, however, probably true, as I have already pointed out, in the case of the Greeks, that the large number of war engines carried in the Roman armies, seriously affected their mobility, and may have induced their generals, more and more, to rely on defensive tactics; nevertheless, many well conceived offensive battles were still fought.

In the Eastern Empire projectile-throwing weapons were for centuries kept at a high grade, but in the West, though they were never altogether lost, they deteriorated in efficiency, and during the Middle Ages, the catapult and the ballista were largely replaced by the trebuchet, an instrument of war apparently unknown to the ancients. This engine obtained its projectile force not by tension or torsion but by the gravitation of a heavy weight, which when released hurled from a beam projectiles of from 200 to 300 lbs. a distance of about 300 yards. A full description of this machine is given in Part IV. of Payne-Gallwey's "Projectile-Throwing Engines of the Ancients."

THUS ends this brief history of ancient artillery, for in the fifteenth century cannon, though not at first so effective, because of their portability began to replace these machines.

As far as the Classical period is concerned, I think, I have quoted every important instance in which artillery, siege or field, was used; anyhow sufficient to draw a moral from this history, so I will now conclude with the following observations.

The origins and development of artillery must be sought in the cities and not in the country side, for there brain-power is concentrated, and as city folk fear the brawn of the peasant soldier, they turn to craft and cunning to overcome it. Artillery has always been costly to manufacture, consequently its evolution and general use has depended largely on the wealth of any particular age. Tyre, Carthage and Syracuse, all wealthy cities, produced artillery in abundance. After Alexander opened the Persian treasuries, and his successors scattered their hoards of gold, we find Alexandria following suit; and when the Romans seized the wealth and trade of the East, a similar military development took place in Rome. In Europe it was exactly the same. The increasing wealth of the fourteenth century gave rise to the adoption of cannon in the fifteenth; and, in more recent times, the increasing wealth of the eighteenth century led to the industrial revolution of the nineteenth, and an enormous development in all manner and kind of projectile-throwing weapons from thirty-inch mortars and eighteen-inch guns downwards.

TODAY mechanization is in full swing, as it was in Alexandria in the third century B.C., and in Rome in the first century A.D. Both Greeks and Romans opened their military history with a cut and thrust cycle, passed through an intermediary cycle in which cut and thrust weapons were mixed with missile-throwing ones, and ended in a projectile cycle, in which the engines used reduced mobility and so detrimentally affected tactics. With nations today this deficit no longer holds good. In naval warfare we have seen a steady evolution from the oar-propelled galley to the steam-driven battleship; from boarding, through bombardment with the intent to board, to battles fought at ever increasing ranges with projectiles alone. On land are we not following a like evolutionary path, now that petrol enables us to carry armor and increase our projectile power? Is not the machine gun steadily eating up the rifle, and will not the tank as steadily eat up the machine gun? If they do, then we shall at length leave the modern infantry cycle behind us, and battles will be fought, lost or won, with artillery, and between artillery, that is by projectile-throwing engines which are no longer handled by the individual soldier, but which are worked and supplied by a team of men. Thus once again may history repeat herself.

References: 1, 2. Chronicles, xxvi, 15. 2. Ezekiel, xxvi, 9. 3. Also see: Vegetius, iv, 22. 4. See below for another reading. 5. Diodorus, xvi, 12. 6. *Ibid*. 7. *Ibid*. 8. Arrian, "Anabasis," i, 6. 9. *Ibid*., iv., 4. 10. *Ibid*., ii, 23. 11. Diodorus, xx, 5. 12. Diodorus, xx, 4. 13. *Ibid*. 14. M. Thevenot, "*Veteres Mathematici*," pp. 73, 74. 15. Philo, iv, 78, 33. 16. Polybius, xi, 11. 17. Livy, xxiv, 34. 18. Polybius, viii, 5-9. 19. Plutarch, "Marcellus." 20. The name of a stringed instrument. This machine was a kind of lift which raised the Roman soldiers from the ships to the top of the walls in baskets. 21. Sir Ralph Payne-Gallwey in his "Projectile-Throwing Engines of the Ancients," p. 35, considers that Plutarch refers to the Sicilian talent which weighed about 10 lbs. 22. A famous giant, son of Coelus and Terra, who had one hundred hands and fifty heads—Lemprière's "Classical Dictionary." 23. Polybius, xxxvi, 6. 24. Strabo, xvii, 15. 25. Livy, xxvi, 47. 26. Plutarch's—"Sulla." 27. Caesar, "*De Bello Gallico*," vii, 25. 28. *Ibid*., viii, 14. 29. Caesar, "The Civil War," iii, 45. 30. Plutarch's —"Antony." 31. Vegetius, ii, 25. 32. Caesar, "The Civil War," ii. 2. Caesar, in ii, 9, states that the best protection against bolts and stones was a curtain, probably woven from cable-ropes. 33. Tacitus, "The History," iii, 23. 34. Josephus, "Wars of the Jews," v, 6. 35. *Ibid*., iii, 7.

Armor Versus Bullets

Modern Developments in Armor Plate (Light) and A. P. Ammunition

By Glenn P. Wilhelm*

LIGHT armor plate such as is used on tanks and armored cars is essentially similar to the heavy armor used on battleships. The technical difficulties of manufacture are really increased by the fact that the plate is thin rather than thick. There are two classes of light armor plate, viz: the type in which the face exposed to fire is hardened over and above the hardness of the entire plate, and a type which has the same hardness or consistency from face to back. These two types are known respectively as "face hardened" and "homogeneous" light armor plate.

The homogeneous type of light armor plate is generally considered superior to the face-hardened type for use where the plate section is necessarily thin. This is because in the thin sections the face-hardened plate has a tendency to shatter like glass when struck by a projectile which otherwise would not penetrate. The homogeneous plate seems to withstand cracking to a very considerable extent, as it is more uniform from point to point on the same plate, and, what is of greater value, from plate to plate and from heat to heat.

Fig. 1. Spark Photograph of Caliber .30 Armor-Piercing Bullet Entering Armor Plate.

Against armor plate we must make an attack with a bullet of suitable characteristics such that at normal striking velocity it will penetrate the armor plate without breaking the core. The term "bullet" is used advisedly, since small arms will be the chief weapons universally present and available in such numbers as to constitute the major obstacle in the progress of the lighter, mobile, armored vehicles. In general, armor-piercing bullets of small-arms type are made with a gilding metal jacket and a steel core which is specially heat treated so that the point of the core which strikes the armor plate will be sufficiently hard to penetrate, whereas the rear portion or body will be strong and tough enough to resist deformation. The dimensions must be held to very close tolerances or the bullets will not be satisfactory. This is accomplished by a centerless grinder which produces bullet cores that have variations in diameter probably not exceeding 2/10,000-inch.

The steel which has been found most satisfactory up to the present time for small-arms bullet cores is what is known as 3 per cent tungsten. In most countries tungsten is a strategic material, so straight carbon steel bullet cores have been developed which are nearly equal to the tungsten cores in effectiveness. The same is true of steel alloys such as chrome molybdenum.

The larger caliber projectiles such as those for the 37-mm. gun and for guns of still larger caliber are made somewhat in the same manner that projectiles for large cannon are produced, and these are what are known as "banded" projectiles. They do not have the envelope or jacket.

When a bullet strikes armor plate the core may break up or it may fuze on the face of the plate. Of course, it is normally hoped that it will penetrate. When bullets strike plates they may produce chips, spalls, and sometimes what are known as "buttons." Chips and spalls are essentially similar, except that spalls are the rather flat and thin sectioned flakes which are driven off the back of the plates that are not penetrated. The question of splash, or the fuzing of the lead cores of the usual service types of ammunition due to the heat of impact against armor plate, is a serious matter to the man in the tank, as will be shown later.

IN the case of armor-piercing bullets it was necessary to develop such bullets for use against armor plate with which airplanes, tanks, armored cars and other vehicles of war are equipped. The caliber .30 armor-piercing bullet will penetrate ½-inch of armor at 100 yards or ¼-inch of armor at 500 yards. The caliber .50 armor-piercing bullet will penetrate 1-inch of armor at 100 yards and ½-inch at 1000 yards. (Above statement depends on striking velocity and type of plate.) Compared with this the M1906 bullet or M1 bullet will not dent armor plate unless it is very thin but will penetrate a considerable amount of mild steel. The caliber .30 armor-piercer was made flat based in order to give the maximum barrel life, as long range was not essential. In the caliber .50 armor-piercing, the bullet was boat tailed to be effective at longer ranges.

Figure 1 illustrates, by means of a spark photograph, the impact of a caliber .30 armor-piercing bullet at a velocity of 2600 f.s. against 1-inch Class B plate. The time of exposure is about 1/2,000,000-second. The cloud-like mass of material being thrown up as the bullet penetrates probably is made up of minute particles of the bullet jacket and lead core surrounding the hardened steel armor-piercing core.

The illumination caused by the incandescent nature of the splash is so great that it affects the spark photograph to the extent of making it necessary to use softer types of armor

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Fig. 2. Penetration of Caliber .30 M. 1906 Bullet (Muzzle Velocity 2700 f.s.) Through 69½ Pine Boards each ⅞-inch Thick.

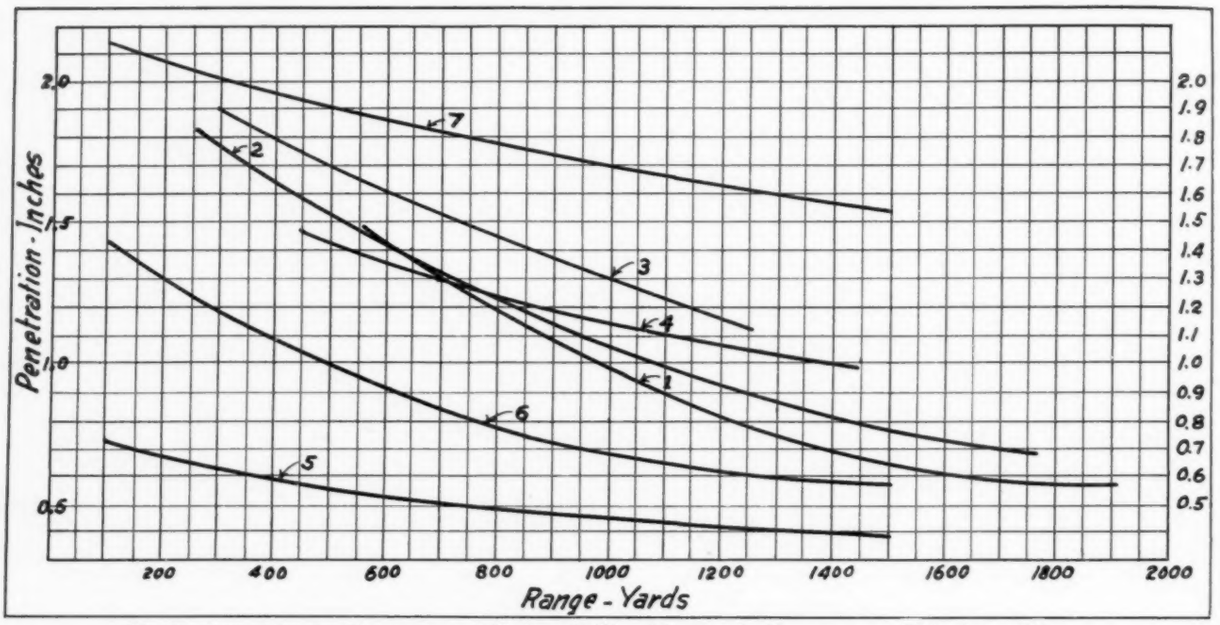

Fig. 3. Curve Showing Penetration of Various Caliber Weapons in Homogeneous Thin Armor Plate.

No.	Cal.	Weight of Projectile	Muzzle Velocity
1.	37-mm.	1.25-lbs.	2800 f.s.
2.	37-mm.	1.66-lbs.	2250 f.s.
3.	47-mm.	3.3-lbs.	2000 f.s.
4.	57-mm.	6.0-lbs.	1450 f.s.
5.	37-mm.	1.25-lbs.	1276 f.s.
6.	37-mm.	1.25-lbs.	2000 f.s.
7.	75-mm.	13.5-lbs.	1450 f.s.

plate rather than the harder types as the latter gave too intense a flash for good results.

The striking energy of service ammunition is not usually realized. The M1906 bullet, which flattens against armor plate without penetration, has been known to penetrate 69½ pine boards ⅞-inch thick. (Fig. 2.)

THE most important factor for the penetration of armor plate is, of course, bullet energy; and since kinetic energy is expressed by the formula $\frac{MV^2}{2}$, in which M is the mass and V the velocity, the importance of velocity is out of all proportion to the importance of the mass. Striking energy, expressed in terms of foot pounds, is usually obtained by a modification of the above formula, as follows: $E = \frac{WV^2}{2 \times 7000G}$ in which W is weight of bullet in grains, G is the acceleration due to gravity (32.2), and 7000 is the number of grains in a pound.

So important is the velocity factor that if very high velocities are obtained over and above the critical velocity of about 3400 or 3500 f.s., ball ammunition will penetrate armor plate as readily as the armor-piercing bullets do at lower velocities. Also there is a considerably greater effect for automatic bursts when concentrated than for single shots. This will be explained in more detail later.

Except at very high velocities the following three factors are of major importance in obtaining an effective armor piercing bullet: a. Hardness of core; b. Form; c. Stability.

Hardness of core. The core must be sufficiently hard to penetrate the plate at the desired velocity without appreciable deformation, but if the core is made too hard it will shatter as the result of its brittleness. It is possible that at very high velocities a softer core is more desirable than the harder cores.

Form. A point on the core is necessary to prevent "skidding." If the point is too thin it will break off; if too hard, it will shatter; if too soft, it will bend or flatten. The shape of point for the greatest efficiency depends upon the type of plate which it is to be used against. The long sharp point is more effective against the soft plate at normal angles of impact. This point, however, against hard plate or at angles of 20° from the normal is not very effective.

Stability. A very small amount of yaw (wabbling) will greatly affect penetration. Yaw insufficient to show "tipping" on a paper screen will seriously reduce a bullet's armor-piercing ability. As yaw increases slightly, ability to penetrate decreases considerably. If the bullet is approaching zero yaw as it strikes the plate, the effect of yaw on penetration is greatly diminished, and, in some cases, eliminated. If the bullet has just passed through zero yaw as it strikes the plate, the effect on penetration is greatly increased and the bullet will probably be turned.

For a given projectile, the period and amplitude of yaw will vary with muzzle velocity and atmospheric conditions. Consequently, for maximum possible penetration, these conditions must be considered. Example: During a recent acceptance test of thin armor plate, a striking velocity of about 2220 f/s was used to fire at ⅜-inch homogeneous plate at a range of 50 yards. It was noted that the first few rounds had so much yaw that they could not be included in the test. The velocity was reduced about 80 f/s with the result that the period of yaw was changed enough to move the point of maximum yaw away from the vicinity of the plate.

THE following factors relating to the physical properties of armor plate are of chief importance with regard to its ballistic resistance: *Hardness*—to turn bullets if possible; *toughness*—to resist cracking or shattering due to impact;

ductility—to prevent buttons or excessive spalling when partly or completely penetrated, and *uniformity of grain structure*—to insure uniform performance from point to point on the plate.

The best representative homogeneous plates have approximately 3½ per cent of alloying elements or impurities and 96½ per cent of iron. Chemical compositions which could be enumerated are practically legion but the alloying elements which have been found to be of most importance in armor plate comprise chromium, nickel, molybdenum, vanadium and manganese.

The effectiveness of armor plate depends not only upon its chemical properties which must be carefully controlled so as to give the best possible combination of physical properties, but it depends also upon its heat treatment, which is a means of adjusting the structure of steel to a particular purpose by means of application of heat.

Fig. 4. Effect of Caliber .50 Automatic Machine Gun Fire With Armor-Piercing Ammunition Against 6½-inch Concrete Slab at a Range of 500 Yards.

NEARLY all available data on armor plate are based upon firing rounds as single shots. This is necessary for precise comparison of different plates and projectiles as armor plate is very expensive. Automatic machine gun bursts, while more effective, do not lend themselves readily for laboratory test purposes although they make an ideal field test.

In general, the resistance of armor plate to penetration of small arms bullets seems to be a function of the hardness as expressed by the Brinnel number. This, of course, provided the plate does not crack or shatter.

The high limit of hardness which is practicable seems to be a factor of the weight of the projectile, and thus it is found that the plate which it is expected will be attacked by small arms bullets is somewhat harder than that designed to resist larger calibers, as the energy of the former is insufficient to shatter a plate which the latter would be almost certain to do.

The amount of penetration, other things being equal, depends upon the angle of impact. Penetration is, of course, greatest at normal impacts and least when the longer axis of the projectile is approaching parallelism with the face of the plate. Up to angles of 20°, penetration is but little affected. If the angle is much beyond 45° the bullet will probably ricochet without effect. A rough rule is that the amount of penetration is decreased about 10 per cent for each 10° that the plate is inclined from the perpendicular.

Before referring to statistics and charts as to the penetration against various types of armor which is obtained with armor piercing ammunition of different types, it will be advisable to show the difficulty of getting a standard type of armor and a standard type of bullet, by reason of the fact that the plate is used to test the bullet and the bullet is used to test the plate, so that when the plate fails it is difficult to determine whether it is because the bullet is extra good or whether the plate is extra poor and vice versa.

It appears easy to standardize the plate, but in the past it has been very difficult, as plates were lacking in uniformity in physical properties, chemical composition and particularly in heat treatments. The same is true of bullets. Moreover, in the case of bullets it is sometimes very difficult to determine whether or not they were stable at the time they struck the plate.

The thinnest types of armor plate are the types used in helmets. This type of plate is ineffective under normal conditions against any weapon more powerful than a pistol except that it will resist penetration at long ranges by ricochets or spent bullets.

THE war time helmet was made of steel known as Taylor-Wharton manganese steel. The general characteristics of the chemical composition are somewhat similar to the homogeneous types referred to, but with certain important differences. The chief differences between this plate and thicker homogeneous plates are a very material reduction in manganese content of the homogeneous compared with helmet plate. It will be noted that manganese content of helmet steel is in the order of 15 per cent. The presence of this large quantity of manganese is necessary in order that thin sheets which are made up into helmets shall not crack or otherwise be rendered useless in the deep drawing process required in the fabrication of the helmet. This type of steel is very tough, but is not as resistant as some of the other alloys.

Helmet plate is made of .04-.05 stock, and in the finished helmet averages about .03-.035, due to the difficulties in forming, which make the helmet thin in spots.

The tests show that the ballistic resistance of helmets of this nature for normal impact with the caliber .45 ball cartridge is as follows: *Average of 10 standard helmets:* Lowest velocity completely penetrated—881 f.s.; striking energy—398 ft. lbs.; highest velocity completely penetrated—886 f.s.; striking energy—402 ft. lbs; ballistic limit—400 ft. lbs.

With regard to laminated plates and plates separated by air space, tests made with plates about ¼-inch thick show that neither type is as good as an equal thickness of plate amounting to the sum of the thickness of the plates which were laminated or separated, as the bullet defeated each plate in turn. If the space could be several inches, so that the first plate would affect the stability of the bullet, then plates separated by an air space would be more effective. Where the laminated plates consisted of a hardened plate for the first plate, the usual result was to shatter the hardened plate and defeat the second plate.

The type of armor which is chiefly used on armored cars and tanks is of the homogeneous type. The location and thickness of armor plate and the range at which caliber .30 and caliber .50 at normal impacts (non-automatic) penetrates for tanks and armored cars are as follows:

For an armored car weighing about 7000 lbs. with a weight of armor of about 1200 lbs., the heaviest armor is usually about ¼-inch thick, which can be penetrated at 500 yards by caliber .30 bullets.

For armored cars weighing about 9000 lbs. with a weight of armor of about 3000 lbs., the heaviest armor is usually about ½-inch thick, which can be penetrated at 50 yards by caliber .30 and at 1000 yards by caliber .50.

For light tanks weighing about 9 tons, of which 1 ton is armor, the heaviest armor of which is about ⅜-inch thick, the caliber .30 will not penetrate and caliber .50 will penetrate somewhere about 500 yards.

For a still heavier tank, one weighing about 15 tons with a weight of armor of about 4 tons, the heaviest armor of which is about ⅞-inch thick, the caliber .30 will not penetrate and the caliber .50 will penetrate only at the shortest ranges.

Of course, weights of armor vary with various types of vehicles, and the thicker armor can be used at a sacrifice in mobility.

More powerful automatic weapons than caliber .50 machine guns can be used against tanks, but they will have the following disadvantages unless the increase in caliber is relatively small: *a*. Too much weight for mobility and flexibility; *b*. Can not be adequately cooled without large amounts of water unless the rate of fire and muzzle velocity are restricted; *c*. Vibration too great for accuracy, and *d*. Complication, as such a weapon lacks simplicity and reliability.

SO far there has been discussed the effect of armor-piercing bullets and projectiles against armor plate when fired in single shots. It was noted in the World War and again conclusively shown in tests that automatic fire has an entirely different effect against armor plate than do single shots. In general, a plate will fail at lower striking velocities when struck by bursts due to attrition, strains or both. Penetration need not be complete for a projectile to have effect. If only a small opening is made in the back of a plate by the nose of the core, there is usually a "squirt" of lead which could do some damage to personnel in the immediate vicinity. Sometimes more than one bullet strikes in or near the same plate, in which case the penetration is greatly increased.

Caliber .30 ball and armor-piercing have more effect against concrete when fired in automatic bursts than is generally realized, but the destruction of concrete by caliber .50 armor-piercing, and particularly ball, is remarkable.

Tests have shown tanks and armored cars to be quite vulnerable when attacks are made on their weak points. These weak points are vision slits, welds in the armor, crevices and in track shoes. Ball ammunition in machine gun bursts, well directed at short range, while not as effective as armor-piercing, nevertheless is often capable of disabling the tank crew.

The following quotation from "In the Wake of the Tank," by Colonel Martel, a British Tank Officer, is of interest in connection with the effect of splash of ball ammunition against light armor: "The question of 'splash' was one which caused us much trouble and necessitated experimental work. When a bullet hits a steel plate, the heat generated fuses the lead and this squirts along the armor plate and enters the tank at any crevices that exist, such as the clearance between a revolving turret and the walls of the tank. This lead enters the tank as a bright flash, and is known as splash.

"If it strikes the skin little particles of lead penetrate and cause loss of blood but not a serious wound; these flashes, however, often caused blindness when they struck the eye during the war. If several enemy machine guns were playing on a tank the splash was often very serious and sometimes the whole crew would be rendered out of action for the time being. Trials were made with fire-proof felt packing round crevices and a good deal was done to reduce the danger. The crews wore goggles with triplex glass and chain masks over their faces which gave them considerable protection.

"It is curious that the Germans never realized the effect of splash on our crews; they fired armor-piercing bullets* which had little effect, but in no orders or instructions did they ever refer to the undoubted value of machine gun fire with normal ammunition for producing splash.

"Many of our tank crews were convinced that the trouble was largely due to the flaking of small pieces of steel from the plates on the inside of the tanks, but though this no doubt happened at times, our trials at our experimental establishments proved that the main cause of these minor wounds was the entering of molten lead through crevices."

This discussion has been limited to the practicable velocity of standard service ammunition. By reason of the publicity which has been given to the Gerlich Halger-Ultra high velocity principle, attention has been centered on the effect of high velocity. Experiments at Aberdeen Proving Ground have shown that experimental brass bullets penetrated ⅜-inch homogeneous plate at 3400 f.s., and that caliber .30 ball, lead core and gilding metal jacketed, has penetrated up to 7/16-inch homogeneous plate at about 3100 f.s.

WHEN the question of the future trend in armor and armor-piercing ammunition is considered, the most striking influence, if it proved practicable, would be the Gerlich Halger-Ultra rifle and bullet just referred to, or the same principle applied in a somewhat larger caliber.

Gerlich claims for a 7-mm. (.276-inch) caliber with a 100-gr. jacketed bullet a penetrating power of 1-inch against face hardened armor plate at 4700 f.s. striking velocity. He also claims great accuracy, short time of flight, flat trajectory, and all accomplished with decreased recoil, decreased metal fouling and decreased erosion.

If the Gerlich principle of design of bullets and barrels is practicable for quantity production and providing there are no unforeseen difficulties connected with their general use under field service conditions, the effect of ultra high velocities may demand a radical change in tank design and tank armor.

The battle of armor versus bullets has gone on from time immemorial. When better armor is made, better bullets are made or the velocity is stepped up, and it is believed that the bullet can always keep ahead of the armor because, as before pointed out, the effectiveness of the bullet increases as the square of the velocity. Therefore, it would appear that the answer to the antitank weapon is not more armor but more *mobility* on the part of the tank. In this connection, there is again quoted from Colonel Martel's book, "In the Wake of the Tank," the following: "Perhaps, on the whole, the arguments in favor of smaller and more numerous tanks outweigh the arguments for the larger machines. In our wars with nature to establish civilization, we have never had any difficulty in dealing with large animals, however fierce they might be; the mammoths were eliminated quite easily, but the lo-

* Not comparable in efficiency to latest types.

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The Permanent Limitations of War

An Analysis of the Forces which Govern Conflict

By Hoffman Nickerson*

ALTHOUGH conflict is permanently human and therefore war—the use of organized force between human groups—is inevitable, nevertheless wars are always more or less limited because the forces which beget and nourish them—the moral, the political, the economic, and the technical—are themselves limited.

This truth is indeed contrary to first impressions. Snap judgment on proposals for limiting war is likely to follow that of the abolitionist William Lloyd Garrison on the measures proposed a century ago for gradually freeing the slaves: "Say to a man whose house is burning that he must sound a moderate alarm. Say to a man that he shall tear his wife from the hands of thieves with moderation. Say to the mother that she shall gradually pull her child out of the fire into which it has fallen." Moreover "absolute" war has been taught by most military writers for over a century, and it seems rash to oppose the long list of authorities beginning with Clausewitz and ending with Foch. Organized violence means death and death is an absolute without shading or relativity.

But has war ever been completely unlimited? If so history would record the extermination of considerable human groups, as wolves have been exterminated over large areas. In fact it seems to contain not a single instance. If one could be found it would seem inhuman in the truest sense—that is, contrary to the whole nature of man. At least the women of the defeated side are assets too valuable to be destroyed by the most ferocious conquerer; they are valuable for their labor, their reproductive power, and usually through sentiment and natural affection. In the vast literature of hatred, the writer can remember only one recorded approval of child killing: in the hundred and thirty-seventh psalm the Jewish poet of vengeance says of the daughter of Babylon "Blessed shall he be that taketh thy children and dasheth them against the stones." Even between bodies of armed men, the extermination of either side is exceptional; notwithstanding the many instances of prisoner killing, mercy is usually shown to those who surrender. Battles between undisciplined men not on fire for some cause or other are hardly more than cat fights—much cry, a very little wool and a total absence of corpses. In every war certain moral restraints are observed; for instance in 1914-18 no country, however hard up for meat and fats, either ate its prisoners or boiled them for explosives. The story that the Germans were boiling down corpses for fat seemed to have arisen because during an Allied advance the heads of two German cooks who had been stirring a large caldron of stew were taken off by a shell and landed in the pot where they were afterwards found along with the other ingredients.

Accordingly the acts of organized violence known as wars are always limited by human nature with its indestructible minimum of moral restraint. They are limited politically because the object of all wars is a better peace, economically by the resources on which the community can draw, technically by the extent of its peace-time knowledge of and preparation for war and by the degree in which it can and will transform itself during the struggle.

At the other end of the scale, no society can completely lay aside arms. No matter how peaceable and well agreed among themselves its members may be, they must have armed police to discourage possible thieves, murderers and rioters. And since communities and their governments cannot reach ideal purity and saintliness any more than the individuals which compose them, there will always be a minimum of warfare, some of it just and some unjust in motive, some for material wealth and some through conflicts of moral and religious passion. Accordingly the practical problem is not that of abolishing war, which is impossible, but that of keeping its destructive effects within bounds.

LET us briefly examine each of the war-making and war-limiting forces. Of the four, the moral is chief. If anyone doubts its supremacy, let him ask himself whether the Crusades would have been undertaken by a pagan society? Put as high as you like the commercial interest of the seagoing Italian republics and the ambition of princes to rule Eastern lands, still the Crusaders fought to recover the tomb of Our Lord from unbelievers. To the Middle Ages, that was a "moral issue." We may contrast their time with our own which saw hardly a man in Christendom volunteer to fight the Bolshevik oppressors of the Russian Church. Great as was the exhaustion of 1919, it does not fully explain so striking a moral change. Again, a medieval would have been amazed to see the religion of nationalism inspire millions to accept the sacrifices and sufferings of our Great War. The consent of whole populations to be drafted and held in service under siege conditions, not to speak of the unquestioned payment of taxes on such a scale, would have seemed to him out of nature.

The moral factor begins with the combative instinct, the inborn love of danger and risk. In practically all men, however, this instinct is soon satisfied. Ardant du Picq, whose monumental *Étude sur le Combat* is the point of departure of the present-day French cult of morale, begins: "Man fights not for the sake of the struggle but for victory. He does all he can to do away with the first and assure the second." The passage continues by showing that the tactics of savages are those of ambush and surprise; the natural man seeks not a stand-up fight against an opponent but a victim who can be assassinated. Since this is so, real fighting demands some real loyalty in the fighters. Their effectiveness may be increased by armament and training, but without loyalty on

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which to build, little more than a cat fight will result. Thus hired soldiers interested only in their pay are usually worthless; the classic instance is that of the Renaissance Italian mercenaries so justly scorned by Machiavelli who would fight battles against each other without a single man killed. Loyalty, however, takes many forms. It may be a strong interest in a particular quarrel, or enthusiasm for an individual leader. It may be that little patriotism of a military unit within itself which the French call *"esprit de corps"*—"the Old Guard dies but never surrenders," or the Tenth Legion, or the British Grenadiers. It was astonishing how quickly divisional spirit grew in the A. E. F. beginning of course with such crack divisions as the First and Second. Usually the loyalty that makes men fight is patriotism for a city or state, or for some form of government or religion. This last is the ultimate loyalty; to rise beyond a certain point, patriotism must have something of religion in it; the citizen must feel that his national ideal is of supreme importance—a sort of God. Like authority, loyalty cannot be made to order.

Although all four factors are closely intertwined, with the moral factor running through the other three, nevertheless the political, economic and technical elements are all necessary to war. The political factor must be present because in order to have a war there must be two groups each with an end to gain by fighting. Group A must say to B "If you go on as you have been doing, or refuse to make good the damage you have already done, I will fight you." And B must reply "I will fight rather than make reparation or give up my policy." The offense may be women-stealing as in the case of Helen of Troy, a slave raid as in the fourteenth chapter of Genesis, or cattle-lifting as in the old Irish epics; at the other end of the scale it may be the proposal of a great state to conquer or impoverish another; the principle is the same. In any case the moral factor dominates the political because each group must have enough cohesion to persuade its individuals to coöperate. No community will begin a war without the certainty of some active consent by the governed. People must be willing to pay and to serve. Governments can deal with considerable amounts of slackness or rebellion but are powerless when these go beyond a certain point. In war the loyalty of the citizens is strained because of the conflict between their individual interests and the public interest. Every man, once his natural combativeness has been satisfied, increasingly dislikes the dangers, hardships and losses of the affair. If the general loyalty be over-strained, the social order dissolves. Authority breaks down; either the armies melt by desertion or the government is overthrown by revolution.

THE economic force making for wars is obvious; it takes the moral—or, if you prefer, the immoral—form of greed for and jealousy of other peoples' goods. On the other hand the economic limitation is absolute: primitive hunters are physically unable to pursue their enemies long after the food in their own pouches is gone; they must then turn aside to kill game, gather nuts and fruit, or seize some accumulated supply. Soldiers in training or on active service cannot support themselves by farming or in any other way; their upkeep and munitionment are therefore a charge against the capital and productive labor which the community can command. Successful wars can be made to pay for themselves either wholly or in part by seizing the enemy's possessions. Not only the amount of wealth in the community matters but also the extent to which it can be made available for supporting war; commercial wealth is more liquid than agricultural. The economic factor modifies the political since communities are slow to begin wars likely to exhaust their resources; in August, 1914, everyone expected a short war, especially the Prussians who remembered their rapid victories over Austria in '66 and over France in '70-'71. Morale determines the amount of sacrifice and hardship a community will stand.

THE third factor, the technical, includes the design, manufacture and supply of weapons and instruments of war, the organization of the armed forces, their training, and the generalship with which they are handled. In part the technical blends with the economic, for the same command over physical nature which serves to produce wealth, serves also to produce weapons. Indeed no small share of the grim irony of material progress springs from the fact that so many of its achievements are potential weapons, from simple devices like the knife and the axe, to the merchant ship convertible into a warship—of a sort, the airplane, the caterpillar tractor convertible into a tank, or the chemical knowledge which makes possible explosives and poison gas. Economics limit military technique in the matter of strategy, that is the way in which armies are disposed in a theatre of war and led to the battlefield, for all strategy depends upon transport and supply which in turn depend upon the economic organization of the country where the fighting is, its density of population, the amount of food and shelter available, the extent to which its communications are organized by means of roads, bridges, and so on. Among the reasons for the crucial defeat of Napoleon in 1812 were the emptiness of Russia and its lack of made roads. Economics also limit military technique as regards tactics, the disposition of troops for combat and the method of fighting, for tactics are designed to fit certain sorts of ground, and ground is modified by human action. For example the highly specialized 18th century tactics—with their rigid formations in line and their shoulder-to-shoulder volleys—suited cleared land, especially the unfenced fields of continental Europe but did not suit the woods of Revolutionary America. On the other hand terrain is only one condition of tactics; the American method of skirmishing soon came into fashion in Europe in the Revolutionary-Napoleonic wars there.

Tactics are independent of economics insofar as they are governed by army organization; those of a long service professional body will differ from those of lower-grade troops. Thus in the 1914 retreat from Mons the British regulars, thanks to their high training in musketry, were able again and again to break off an action and retire in safety from before greater numbers of short-service German conscripts. The Germans seem to have believed the Old Contemptibles to have been heavily armed with machine guns, not imagining that such volume and accuracy of fire was possible from shoulder rifles. It is true that a community must have reached a certain moderate economic level before it can support a professional army, but once this has been achieved it has its choice between professionals, short-term troops, or mixed forces. The reasons for this choice are complex; at bottom it is determined by the social organization and political motives, in short the morals, of the community in question. A state intent on holding distant and exposed possessions is almost compelled to do so by professional troops, whereas most primitive folk expect all their able-bodied free males to be warriors—on part time. States insistent on repose prefer either long-term pro-

fessionals or wholly improvised troops. Everyone knows the weakness of these last in proportion to the effort put into them; they can solve only the easiest military problems, and that wastefully. On the other hand, professional armies too have their limitations; being expensive per man they must be small. Further, the training of their recruits takes a long time; accordingly, whatever their spirit of sacrifice and ability to stand heavy loss without breaking, their generals must think twice before throwing them away lavishly. That which cannot easily be replaced must be used cautiously; we may compare Jellicoe's reluctance to risk his huge, costly and irreplaceable mastodon battleships at Jutland; he was the only man on either side who could have lost the war in a single afternoon. So on land, only commanders supplied with abundant and cheap recruitment can be prodigal of blood. For some jobs you must have numbers, for instance to defend very long lines or to occupy and hold down large areas densely populated with high spirited folk of a civilization not much below one's own. Accordingly those rare civilized states which have prepared for the greatest military effort and have put forth their entire fighting power have always tended to armies of mixed type in which a considerable professional element leavens an enormous mass possessing some training and recruited under universal compulsory service laws. We are all too familiar today with the terrible reaction from such efforts when prolonged. In unusual crises the entire adult community tends to be drawn in; in certain besieged cities and other rare cases of desperation, even women have fought. Thus the nature, and purposes of a community are closely intertwined with the type of armed force it chooses, each having its advantages and disadvantages.

AT this point a possible objection must be met. Materially-minded people, while admitting the increased savagery and destructiveness of recent wars, sometimes say that these evils are due chiefly to the new weapons and consequent increased power of destruction possessed by man through the late advances in the physical sciences. It is indeed unhappily true that the possession of new mechanical devices often encourages their possessors to disregard old moral restraints. Thus in the World War we saw naval officers who, had they been acting from surface ships, would not have dreamed of sinking merchantmen without first putting those on board in a place of safety as required by the universally accepted rules of war, ruthlessly doing so from submarines. Again, take the use of poison. Savages have always used it on arrows. Over and over again throughout history it would have been advantageous for retreating armies to have poisoned the wells they left behind them. And yet it was not done, whereas poison gases were freely used by both sides from 1915 to 1918.

On a smaller scale the same principle may be daily seen at work. People who would be ashamed of screaming or beating drums to the annoyance of their neighbors think nothing of doing so with radios and outboard motor-boats. And so with the careless or deliberate use of speed-boats, airplanes and automobiles.

But when all this has been granted, the materialists must in their turn admit that the essential point is not the existence of the new devices but the willingness or unwillingness of people to use them in certain ways. It is true that morals depend much upon traditional habit, whereas new devices have no tradition of restraint in their use. On the other hand, there are equally familiar instances of rapid moral conquest over new machinery. Twenty years ago automobiles had muffler cutouts, and with his the writer in his hot youth used to delight in making a hellish din, especially in the quiet hour just before dark. But the automobile manufacturers soon saw the light and their present products do not permit this foolish amusement. The motorcycle, the outboard motor and even the airplane may soon, please God, follow the automobile engine into comparative noiselessness.

In the matter of killing people, one is just as dead if finished by a club, or stone as if one's exit is accompanied by the full devil's orchestra of the most modern science. For that matter, hands and feet are often deadly enough. In my boyhood a certain weaponless Irish coachman once killed a far more dangerous foe than the average unarmed man, to-wit, a great Dane dog which attacked him. He choked it insensible and then jumped upon it until he had smashed all its ribs. Death cannot be made more terrible by complex instruments. Moreover, as a certain poet named Homer, not unknown to the pre-jazz age, remarked in the Odyssey:

> "For an enduring heart have the destinies given the children of men."

In other words, the race has a considerable power of standing up to things. Even outside of death in battle, in the matter of torture the Bolshevik has probably improved but little on the Red Indian. So much, then, for the general refutation of the materialist argument.

So common is the materialist muddle of many modern minds that it is necessary to insist as strongly as possible that the degree of limitation in war has nothing to do with the deadliness and destructive power of weapons but is a moral question. In every discussion of the present danger of the civilized world one finds numbed intelligences wearily droning out variations of the same fallacy which all military history combines to condemn. Therefore at this point in our analysis let us fix firmly in our minds that the exhausting wars of the later Roman Republic were fought with the same swords, spears and javelins as the limited wars of the Roman Empire. Just so the Revolutionary-Napoleonic wars were waged with cannon and muskets precisely like those used in the Eighteenth Century limited wars between kings. As regards destruction, Rome needed no high explosives to blot out Carthage and Jerusalem; fire, human muscle, and her white-man's hatred of the Semitic soul were enough. As civilization advances on its material side, increased power to destroy is more or less balanced by increased power to protect and build. Again, the cat fight shows that the deadliness of weapons has nothing to do with the amount of killing, for as regards each other two cats are formidably armed. As far as weapons go, ancient battles fought hand to hand or at the shortest ranges seem to have been more deadly, at least to the defeated side, than modern combats of the same size and duration. Raise from two bitterly hostile populations two armies, discipline them and train them to fight with sticks and stones, and there is nothing to prevent their killing each other off to the last man—if they choose. The strict limitation of war is not a technical but a permanent human problem successfully solved again and again in the past. What matters is first the will to fight, second the extent to which the community is involved in the struggle, third the amount of damage inflicted before a decision is reached. The first is a moral question; the second and third are divided between morals and military technique.

RETURNING to our analysis, since we have seen that all four limitations of war are permanent, the reader may ask what so many intelligent men have meant by "unlimited" or "absolute" war? The answer is that they used the term "unlimited" in a restricted sense and only with regard to the political object sought. Whatever the errors of Clausewitz' commentators, the great Prussian military philosopher himself was clear on this point: when he spoke of unlimited or absolute war he meant that in which the political object is the complete overthrow of the entire hostile group. For him limited wars were those in which the political objective is limited, that is when the force used is intended to injure the enemy and persuade him to terms but not totally to conquer or disarm him. The Spanish-American and Russo-Japanese conflicts are good examples of wars limited by political objective. In 1898 the American objective was to drive Spain from Cuba; secondarily to strengthen the United States, in the Caribbean by occupying Puerto Rico and in the Far East by conquering the Philippines; there was no intention to invade Spain itself; the object could be obtained without such an operation. Nor did the Spaniards try to invade the United States; their object was merely to retain their colonies and when these had been captured they did not think it worth while going on. So in 1904-5 neither Russia nor Japan intended the complete overthrow of the other; the ambitions of both sides were limited to Korea and Manchuria. When the Japanese had occupied these territorial objectives, and when the Russians found that the strain of war was telling upon their own flimsy social structure, both were ready for peace.

When your political object is "unlimited," that is when you mean to conquer your enemy altogether, either to destroy his independence by annexing all his territory or to disarm him completely and dictate peace on your own terms, then it is true that all the permanent limitations are lessened. The enemy, seeing that you mean to injure him greatly, will make more effort than if the intended injury were slight. If he be powerful, then you in turn must make a greater moral, political, economic and technical effort. How great your effort will be—within the limits of what is economically and technically possible—will depend on the morale of your people. Accordingly most great wars have been fought for "unlimited" political objects. Nevertheless Clausewitz' distinction between limited and "unlimited" objects, however valuable, does not explain why certain societies have limited war so much more successfully than others.

The answer seems to be that the amount of war within a society depends upon the degree of moral disunion within that society. We have seen that an ideally virtuous world would need no weapons at all, and that in practice armed police work against an occasional criminal is the irreducible minimum of soldiering necessary to any human group. While a certain amount of violence may be a mere expression of energy, in a well unified society the fighting instinct goes into police work, since practically everyone accepts the ideas of right and wrong prevailing in that community. But if crime increases, that means an increasing minority hostile to the accepted standards; or suppose that there is increasingly angry debate as to the justice of this or that law or social arrangement; in either case moral disunion is causing social strain.

As with civil, so with foreign war. In a sense, all mankind constitute a single society to which lesser units belong. Every war is as much a conflict of moral ideas as of weapons. Take the most limited cases: A must in effect say to B "You have no right to this or that which you possess, at least no better right than myself." Or "You have injured or shocked me so much by what you have been doing that I will compel you to change your ways." In the graver cases A says "You have no right to your independence. I will make a better world by compelling you to pay me tribute, or to be my subjects, or my slaves." To carry through a great military effort, the citizens of A must believe that the men of B are either wicked or inferior, that is they must feel themselves morally divided from the B men. Or else the A men must be discontented; otherwise they would say "why should we cross the border in arms when our own land already gives us enough and to spare?"

THUS discontent and moral disunion are the causes of strife. Without diminishing them, to try to diminish war is futile. Fuller has well said that to say "Stop all wars" without removing their causes is to say "Let there be no more tides" without abolishing the moon. He has also added to Sherman's epigram "The legitimate object of war is a more perfect peace," the equally pregnant words: "The legitimate object of peace is a more perfect man."

Alas, what might constitute a perfect man is a philosophical and religious question on which mankind is not yet agreed. We may note, however, that the harm done by war is only partly physical—the destruction of wealth and the loss of life. Still more important is the moral damage: should a war lower the accumulated spiritual values so that men say "we are baser than we were," then the replacement of the incidental physical destruction by no means ends the injury. On the other hand, when the community continues to agree that the war was just, then moral force is not so much lowered. Indeed some wars, even great wars, are not spiritually destructive but fruitful, raising the spirit of the group so that the physical destruction is presently swallowed up in a prosperity greater than before.

Whether any given great war may result in physical and moral destruction so serious as to threaten disaster to society depends greatly on the time it takes to get a decision. Although the causes which start hostilities are moral, and although a breakdown of morale on either side will end the struggle; when once the fighting begins, technique and chance determine the course of events. A long and great war without a decision makes the mere combative instinct prevail over the original and reasonable desire for a better peace than that which went before, until both sides feel the approach of calamity and both continue to fight only to avoid the greater evils sure to follow defeat. If one or more of the permanent limitations did not interpose a check and if the war were indefinitely prolonged, then the fighting groups would risk extermination. Happily this at least has never happened in history. The extreme penalty of social dissolution is bad enough. Although great wars are in themselves calamities, they are nature's (or God's) instrument for ridding the earth of diseased societies which can find no remedy for their evils.

If this analysis be sound, one would expect to find in history: first that the civilizations which have suffered greatly from war have been those in which grave moral disunion existed; second that all reasonably stable civilizations have owed their security to their degree of religious and moral unity which has enabled them strictly to limit war by putting force behind agreed and admitted right.

The Ballistic Efficiency of Guns

A Great Increase of Velocity Has Been Attained

By H. Gerlich*

Since this article was prepared for ARMY ORDNANCE *the author visited the United States and demonstrated for the Ordnance Department at Aberdeen Proving Ground the rifle and projectile referred to in this discussion. It is understood that the results of the demonstration and tests confirm most of the claims of the author.—Editor.*

UNDER the above title with the questioning sub-heading, "Has a Great Increase of Velocity Been Attained?", an article by Lieut. Gen. H. Rohne of the German Army, was published in the March-April 1932 issue of ARMY ORDNANCE. This article was a translation republished from the December 1931 issue of *Zeitschrift fur das gesamte Schiess-und Stoffstreng-wesen,* Munich. A reply to the article in the German publication from my own pen was published in the July 1932 issue of that well-known German technical paper. Since General Rohne's article has been published in these pages, of which fact I became informed only lately, I am herewith publishing my reply. ARMY ORDNANCE was the first scientific journal in the United States to present some months ago an authentic article on my developments and I am therefore grateful for this opportunity to reply to General Rohne.

The contents of the General's article undoubtedly caused a smile on the part of many engineers, scientists and military authorities at home and abroad, particularly among those representatives of several armies who have had occasion to witness and personally fire my Ultra-rifle. These observers and institutions have long since convinced themselves of the correctness of the statements I made in descriptive articles first published in *Wehr und Waffen* (April and July 1931), *Kugel und Schrot* (April and June 1931), ARMY ORDNANCE (September-October 1931) and others. Since these writings describing my initial undertakings I have obtained even more decisive results.

In reply to General Rohne, who has attempted to supply by mathematical formulae and calculation proof of the practical as well as theoretical impossibility of my results, I would like to cite that those officials of the several leading military powers who have considered my invention have done so exclusively on the strength of the results obtained by themselves in connection with their own tests. In spite of this, General Rohne believes he has finally proved by elementary calculations that my achievements are technically ridiculous and impracticable. Actually he could not be enveloped in a more catastrophic error. And this is quite apart from the fact that the general contradicts himself in his original article by first stating that he does not doubt the correctness of the velocity checking published and by emphasizing later-on that such velocities by necessity must be considered as "being in absolute and ridiculous contrast to all mechanical laws."

If I may be excused for an apparent digression I would like to recall the concluding sentences of my original article published in *Kugel und Schrot* (No. 4, April 15, 1931). On that occasion I pointed out with full justification the severe handicap placed on most technical pioneers by the general attitude of official and semi-official red tape professorism. I for one received not only a full but at least a treble share of this irresponsible treatment. Somewhat abridged these former statements of mine were as follows: "The fact that I have been successful in proving the complete incorrectness and fallacy of all those critical statements and technical forecasts made to me verbally and in writing by official and unofficial ballistic experts is a cause of special satisfaction considering the practical results obtained. This satisfaction is all the greater because the judgment of many of these so-called experts culminated in *official* statements that my developments were successful. This in spite of the fact that my calculations and forecasts had in some quarters been declared to be impracticable. Notwithstanding these views I have succeeded in putting my ideas into practice with a certainty of 100 per cent success." Hence it is not without some special justification that I feel convinced that certain German military doctrinaires—be they official, semi-official or unofficial—deserve some special appreciation for they are, in all probability, as weak in practical analysis as they are "infallible" in theory. For this reason I regret that General Rohne, who is a writer on technical military topics has achieved fame in Germany and throughout the world, has shown such weak spots in his article.

Since he can not possibly have any other information with regard to my attainments than that published in the articles referred to above, he ran a great risk in revealing the weaknesses shown in his own refutation. For it was highly dangerous to attempt to prove the impossibility of my results without troubling to acquire a better and more intimate knowledge of them. His theoretical criticism, the basis of which is totally erroneous, and his attempt to prove in such a way the impossibility of my results, were at least premature. It may have the effect with some weak and doubting souls of delaying further developments of important military application.

Moreover, it should be pointed out that General Rohne has rigorously declined to accept the voluntary invitation which I have extended to him in open print to personally witness a demonstration and to personally fire my Ultra-rifle. Unfortunately his sportsmanship as a ballistician prefers theoretical paper criticism to the actual eating of the pudding which after all is the real and only proof. To me such an attitude seems hardly fair.

The erroneous premises adopted by my critic are naturally leading him to wrong conclusions. By his elementary calculations he has proved that by the usual standard construction of barrels and projectiles and with the usual means heretofore

* Author: "Increased Bullet Speeds," Army Ordnance, Vol. X, No. 60, May-June, 1930; "An Advanced Era of Bullet Velocities," Vol. XII, No. 68, September-October, 1931.

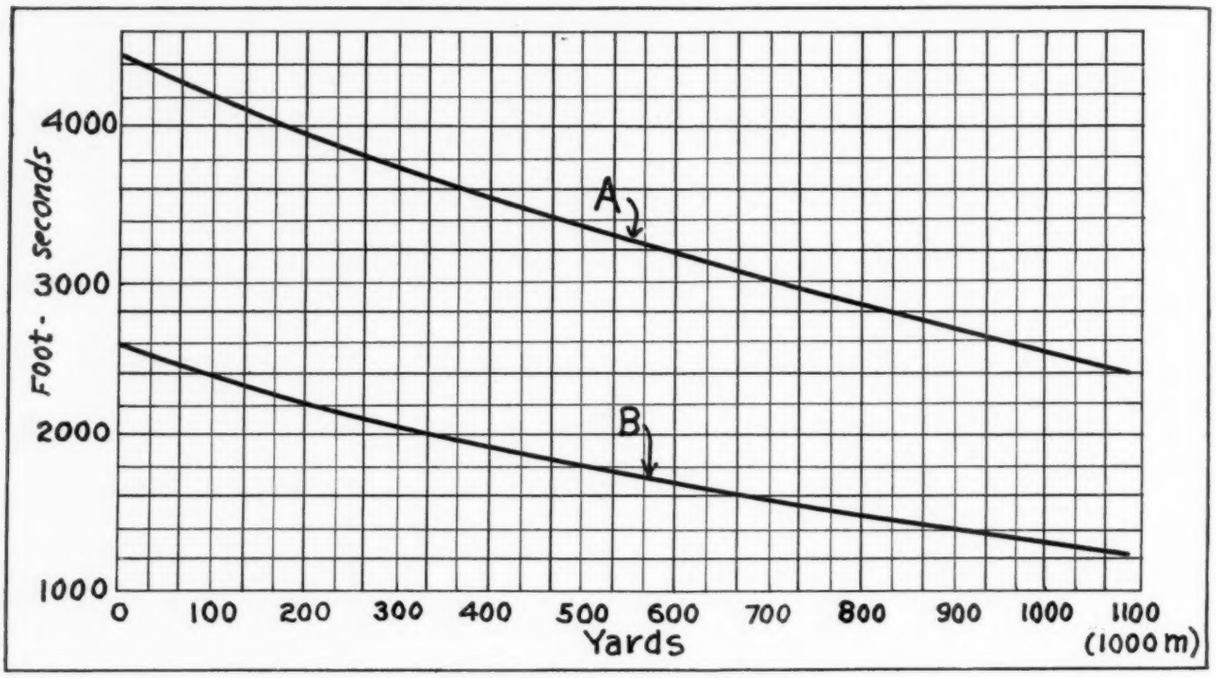

Fig. 1. Comparative Striking Velocities.

The recordings are from the muzzle up to 1000 meters (1094 yards). A is the curve of the 7-mm. 126-grain Halger Ultra-bullet, muzzle velocity 1358 meter seconds or 4445 foot seconds. B is the curve of the 7.9-mm. 197-grain German service bullet, muzzle velocity 780 meter seconds or 2560 foot seconds. It should be noted that the velocity of the German service bullet is analogous to the velocity of the U. S. Army service cartridge caliber .30 firing a 173-grain boat-tail bullet with a muzzle velocity of 805 meter seconds or 2640 foot seconds.

used it is impossible to solve this preponderant problem. The problem consists in increasing the ballistics, efficiency and effects of our modern firearms and in eliminating at the same time those drawbacks which heretofore have rendered such attempts futile and impracticable from the very start. The general has done nothing else with his calculations than to reaffirm this fact. Incidentally it may be pointed out that in criticizing my realization of the velocity of 5710 ft/sec an elementary mistake was made by General Rohne. In calculating his formulae, which when applied to standard barrels and projectiles are correct enough, he shows for instance that in order to propel a 7-mm. projectile weighing 6.5 grams with an initial velocity of 3000 m/s or 9842 ft/sec an average or mean gas pressure of 110,700 kg/cm² is required. Taking a pressure ratio of 0.5, as the general has done, this would result in a maximum pressure of 221,400 kg/cm² or just about 1400 tons per square inch. Aside from the fact that my pressure-ratios are much higher than 0.5, the general's figures are obviously wrong by a whole decimal; i.e., they are ten times too high. In view of the resulting muzzle energy of 2980 m/kg. and in connection with the bullet's travel within the 7-mm. bore of 0.7 meter length, and under the premises of the general's calculations, this maximum pressure would be $\frac{2980}{0.7 \times 0.385} = 11{,}070$ kg/qcm. I point out this mistake without touching others and venture the opinion that such a regrettable slip should most certainly not have been made.

In further reply to General Rohne I am in a position to state emphatically that the ballistics which I have realized with my Ultra arms are obtained without difficulty as regards

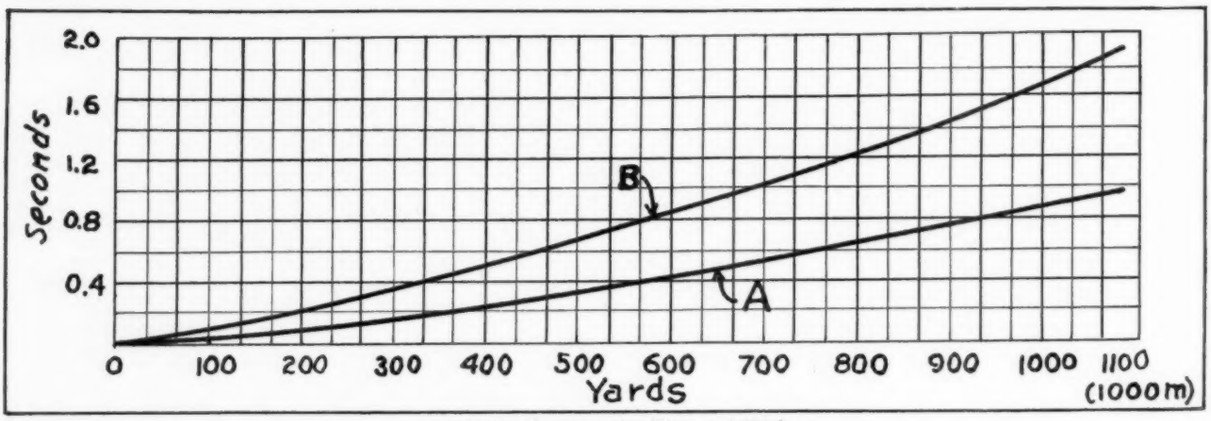

Fig. 2. Comparative Times of Flight.

The diagram is of comparative times of flight up to a range of 1000 meters or 1094 yards. A is the 7-mm. 126-grain Halger Ultra-bullet, muzzle velocity 1358 meter seconds or 4445 foot seconds. B is the 7.9-mm. 197-grain German service bullet, muzzle velocity 780 meter seconds or 2560 foot seconds.

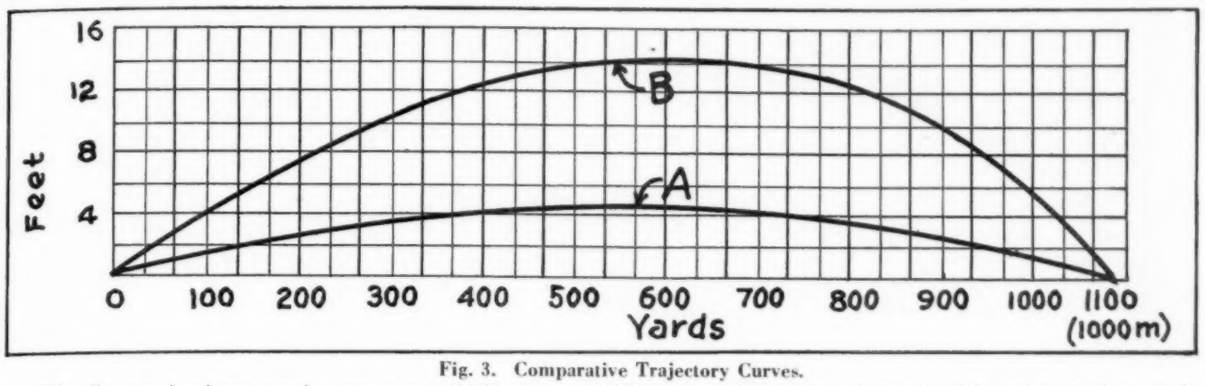

Fig. 3. Comparative Trajectory Curves.

The diagram is of comparative curves over 1000 meters or 1094 yards. A is the 7-mm. 126-grain Halger Ultra-bullet, muzzle velocity 1358 meter seconds or 4445 foot seconds. B is the 7.9-mm. 197-grain German service bullet, muzzle velocity 780 meter seconds or 2560 foot seconds.

length of barrel and weights of the respective arm which may be even shorten or longer than those of our present standard which are admittedly suitable for actual warfare. Similarly I may refer to the extraordinary results which General Rohne arrived at by his calculations in connection with the maximum gas pressures required to realize the energy actually obtained from my arms. Personally I have neither attained the Rohne pressures nor was it my intention to do so especially since they were not at all required for practical results. Indeed I have been entirely satisfied to use maximum gas pressures not very appreciably higher than the average mean pressure over the whole travel of the bullet within the bore required, according to General Rohne, to obtain the velocities of the various 7-mm. bullets in question. Astonishingly enough, I have realized those very high projectile velocities—high only in comparison with our *present* projectile velocities—and have enormously increased projectile energies. And what is more I have obtained these results without "defying the laws of mechanics."

WITH regard to the relative figures of the efficiency of the powder load, it may be pointed out that I have succeeded in obtaining increased mean effective pressures over the whole length of the projectile's travel within the bore without raising the maximum gas pressure. Without discussing here in detail the thermic efficiency itself it should be said that the number of foot pounds developed in the ultra-rifle by the weight-unit of the powder load is relatively appreciably higher than in the case of our present firearms of standard construction.

Again, another capital error is the general's presumption that in the course of the tests only a few rounds were fired and consequently the firearm was not placed under nearly as great a strain as would be placed on it under actual service conditions. On the contrary appreciable numbers of rounds have been fired in quick succession from a single Ultra-rifle from the shoulder itself and I am personally using my rifle invariably in this way. I would also like to say that even a single round from a rifle which would develop maximum gas pressures such as calculated by General Rohne in his study would either ruin the rifle or render it useless even though it were fitted with such an excellent action as the Mauser. Our present brass cases would not stand such Rohne pressure as every practical manufacturer and experienced rifleman knows. If they did not burst they would interfere at once with the proper functioning of our standard military actions. Furthermore I beg to assure the general that on this score my results are attested by my coöperators and others who have themselves tried my rifle or who have witnessed such tests. Here he is dealing with real practical results.

In addition to all this, it should be stated that if I had succeeded in increasing the present-day ballistics of our most efficient firearm by ten or perhaps twenty per cent or so, the so-called ballistic authorities undoubtedly would have endorsed them. Since, however, I have succeeded in increasing in a single step by 100 and 200 per cent and more, the only recourse of the "infallible" portion of such critics is merely to deny the possibility of such results in spite of all facts and proofs to the contrary. I hesitate to suggest that this reaction may be due in certain quarters to "special orders." In any event the biggest handicap to a more general recognition of my work, aside from the secrecy with which my tests are veiled, has been this very attitude. Nevertheless the truth is leaking through irresistably at an increasing rate of acceleration. Nor can this be stopped—to cite the reaction of the Editor in his well-founded comment in his pages 349-350 of the March-April issue of ARMY ORDNANCE. Facts have always been stronger than theories of even the world's leading authorities and in this case the facts are invariably in contradiction of theory.

My own observation is that with this mere beginning of a

RANGE		Striking Velocity	Striking Energy	Time of Flight	Height of Trajectory	Velocity
Meters	Yards					
0	0	1358 m/s	765 m/kg	....	.... cm	4445 ft/sec.
100	109.335	1260	659	0.044	0.4	4135
200	218.670	1184	583	0.112	2.1	3885
300	328.000	1115	516	0.195	6.1	3660
400	437.340	1050.5	459.5	0.289	11.8	3450
500	546.000	989	405.5	0.39	21.0	3242
600	657.000	930.5	360	0.50	35.9	3059
700	765.345	875	318	0.61	53.0	2870
800	874.680	822.5	281	0.73	73.5	2700
900	984.015	773	248	0.86	95.2	2538
1000	1093.350	726	219	0.98	120.0	2382

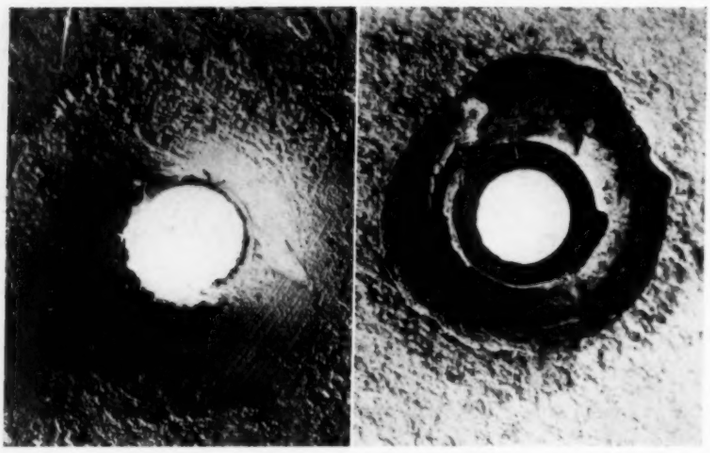

Fig. 4. Penetration of Armor Plate.

These shot holes (actual size) were made by soft, i. e., no steel core or other armor piercing device, 7-mm. Halger Ultra- 126-grain bullet through hardened chrome nickel armor plate 15-mm. (about 5/8-inch) in thickness At the left is shown the entrance side of the bullet; at the right the exit side. The specifications of the armor plate were: chromium 1.25 percent; nickel 3.70 percent; breaking stress 82.4 kg/mm²; limit of elasticity 61 kg/mm²; elongation 13.5 percent.

new era in ballistics there is but a very slight approach to the feats of the one and only real Artillerist whose projectiles have been fired for unthinkable ages and which still travel as fast as ever. They are the projectiles of the Great Ballistician of the universe. But perhaps some authority will prove by theory that even these feats are impossible and contradictory to all laws of mechanics.

IN the following paragraphs I limit myself to make public additional ballistic data of one of my 7-mm. Ultra-bullets fired from my 7-mm. Halger Ultra-rifle obtained at a distance of 1,000 meters or 1094 yards about one year ago. Although these data are already superseded they have the convincing advantage that I am at liberty to publish them. Incidentally this same cartridge with exactly the same load and bullet has been tested in certain official quarters and the results of these official tests were within a few foot seconds identical with the following figures. The bullet in this instance weighed 8.15 grams or 126 grains and had a muzzle velocity when fired from my first experimental rifle with a fairly soft loading of 1358 m/sec. or 4,445 ft/sec. The table on page 217 gives the ballistic data and performance of this load and bullet obtained from my experimental rifle at ranges of from 100 to 1000 meters.

The trajectory curve (Fig. 3) was obtained by shooting through screens placed at intervals of 100 meters. In the diagrams (Figs. 1 and 2) the velocity and time curves plotted from these figures are shown in direct comparison with the respective curves over the same ranges and up to 100 meters (or 1100 yards) of the present German service bullet when fired from the German 7.9-mm. service rifle according to the official tables issued by the German government. This German service bullet is of 7.9-mm. caliber, of the boat-tail Spitzer type (so-called s.S. bullet) and weighs 12.8 grams. It will be seen that the striking velocity of the 7-mm. Ultra-bullet at a distance of 900 meters, or about 1000 yards, is the same as the *initial* velocity of the very efficient German bullet at the muzzle of the long-barreled German service rifle. The heights of the 1000 meter trajectory of the Ultra-bullet in question is just about one-quarter of the trajectory height of the German service bullet over the same range. The time of flight of the Ultra-bullet is 0.98 seconds over 1000 meters as against 1.87 seconds of the German service bullet.

This same 7-mm. Ultra-bullet proved also to be astonishingly accurate over these long ranges. The accuracy results, no doubt, from the extraordinarily flat trajectory of this projectile and is evidently in accord with the well-known ballistic axiom that in a balanced projectile trajectory and accuracy are inseparably joined. This soft metal projectile which was not fitted with a steel core or any other armor-piercing device penetrated, regularly and without a single exception during the various tests, modern armor plate of highest resistence such as chrome nickel steel and other compound steel armor plate used in connection with tank armor, etc. up to thicknesses of three-quarter inch and more. I may state further that the penetration of these plates by Ultra-bullets with their highly increased velocities proved to be the same in all instances whether the plates were hardened throughout or were only glass hard on their outer layers with an exceptionally toughened core of maximum resisting power of hardness gradually decreasing toward the center of the plate.

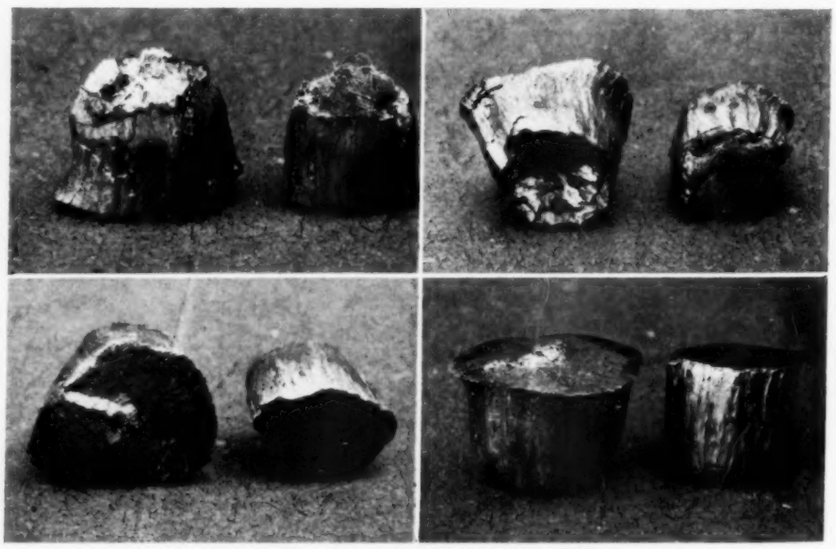

Fig. 5. Plugs Punched Out of Armor Plate.

The plugs are actual size. They were punched out by 7-mm. Halger Ultra 126-grain bullets with no steel core or other armor piercing device. They were punched from chromium nickel armor plate of maximum hardness throughout.

At the left the plug is from armor plate practically 3/4-inch thick; at the right the plate is approximately 5/8-inch thick. The shot holes through these plates showed diameters of up to nearly 1-inch with large parts of the material blasted away around their edges on the exit side. The plugs were recovered imbedded about 1 1/4-inches in a thick pine wood screen covered with fabric standing about 24-feet behind the pierced armor plates.

Furthermore these Ultra-projectiles without steel core striking the plates at angles of 30 or 40 degrees and more did not ricochet but penetrated either completely through or into the plates showing almost the same penetration as if striking at a right angle. These penetrations by projectiles striking armor with velocities above the critical limit were invariably accompanied by destructive effects especially on the exit side of the plates. Ultra-projectiles of course may be fitted with armor-piercing steel cores of the accepted types. In such an event highly increased penetrations may be realized by the increased mechanical effects. This is natural from the highly increased striking velocity in comparison with the present military armor-piercing steel core bullet of much lower initial and striking velocity. Effective range of such bullets may be decisively increased as compared with the relative effective ranges of the present bullets of this type. As I pointed out in my first article, the final scope and possibility of development along this line cannot be defined or limited at present. The application to armored cars, tanks, airplanes and other mechanical weapons indicates revolutionizing results!

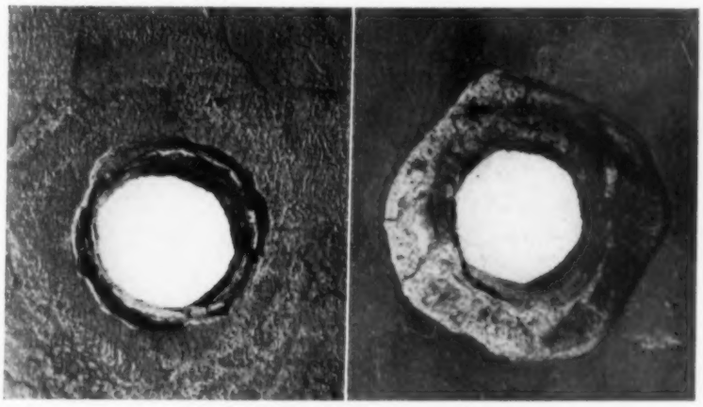

Fig. 6. Penetration of Armor Plate.

These shot holes (actual size) were made by soft (no steel core or other armor piercing device) 7-mm. Halger Ultra 126-grain bullets through hardened chromium nickel armor plate 10-mm. (about ⅜-inch) thick. At the left is shown the entrance side of the bullet; at the right the exit side.

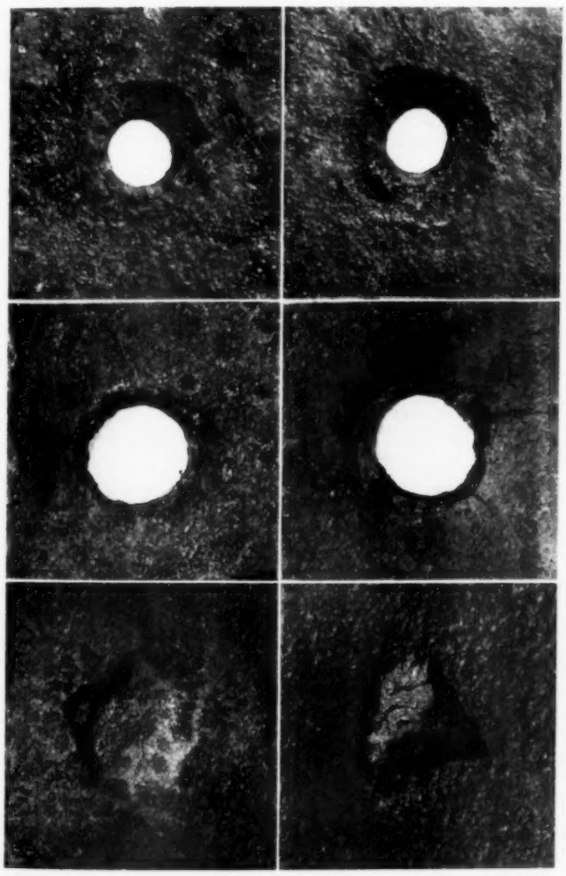

Fig. 7. Penetration of Three Thicknesses of Armor Plate.

Holes (nearly actual size) made by soft (no steel core or other armor piercing device) 7-mm. Halger Ultra bullets (126-grain) through three hardened steel plates at a range of 60-meters. Photos show: on left, entrance side and on right exit side of plate. The three plates were placed one behind the other ten centimeters apart. The first plate (top row) is ten millimeters thick and was struck by perpendicular impact; the second plate (middle row) is 7½-millimeters thick; the third plate (bottom row) is twelve millimeters thick. The two latter plates were inclined and were struck at an angle of 20-degrees. As will be seen, the bullet penetrated the first two plates and embedded itself in the third to a depth 6 to 7-mm. From the back of the third plate (right, bottom row) fragments were blasted out by the concussion to a depth of 4-mm. The bullet lodged in the third plate (left, bottom row) having penetrated 24-mm. or practically 1-inch of hardened steel plate.

WITH reference to the photographic reproductions of shot holes made by soft lead core Ultra-bullets published in the September-October 1931 issue of ARMY ORDNANCE, I am supplementing these with the illustrations published herewith which I am at liberty to reproduce. The respective conditions and details are stated specifically in each case. I am sure readers of this Journal will be interested in them as also in the photograph taken of a 7-mm. Ultra-bullet after its penetration of armor plate, the combined thicknesses of which were practically 1-inch, and also of the plugs punched out of the very hardest armor plate of extreme resisting capacity up to 18-mm. in thickness.

I offer these in evidence remembering that General Rohne has characterized the medium by which such results were obtained as "impossible," my entire investigation "a basic error" and "contrary to all laws of mechanics." Mankind has ever been, and ever will be, the image of the spirit it is able to conceive and understand. For its vast and uncreative majority such a viewpoint as that expressed by General Rohne must be characterized as incredulous and negative in the face of demonstrated results to impartial observers—and this in spite of Germany's avowed republican maxim "Free course for the doer." I look forward to the day when I shall be given an opportunity to demonstrate under strict control the complete correctness of my claims and results in the United States of America—the home of practical riflemen and artillerymen who have made their history.

Fig. 8. The 7-mm. Ultra-Bullet After Penetrating Armor Plate.

Above is shown the bullet slightly less than actual size. The photographs show the mushrooming which is also evident from the successive shot holes (Fig. 7) which became gradually larger.

Maneuvers of the British Tank Brigade

Observations on the 1932 Exercises of an Army in a New Form

By B. H. Liddell Hart*

FOR the second year in succession, but with a new addition, the 1st Tank Brigade of the British Army was assembled on Salisbury Plain.

The Brigade comprised the bulk of the armored fighting force of the British Army, some 230 tanks being present altogether. This steel-clad array certainly looked impressive, all the more so because of the high pitch of maneuver now attained by the tanks in battle drill. And the number sounds imposing. But cool analysis reduced its significance, for some eighty of the machines were the little Carden-Loyd machine gun carriers, which are unsuited to a high-speed light tank role. As for the 100 medium tanks, they are really too old in years and too thin in armor-plate for employment against a properly equipped modern army, although they may still be formidable against tribesmen. The balance of fifty machines was composed of the latest Mark 2 light tanks.

The appearance of these light tanks constituted the distinctive new feature of the 1932 exercises. Last year, there was only a sprinkling of these mechanical racehorses, and these few were required for the use of commanders and orderly officers. But this year there were sufficient to form a complete battalion—the First Light Tank Battalion.

Fifty sounds a lot, until we remember that the annual cost of one of these light tanks is only equivalent to that of a couple of infantrymen, and that, in comparison, we maintain over 100,000 of these unprotected, foot-slogging, rifle-and-bayonet men. For practical purposes the proportion is rather disproportionate, especially in view of the way in which the machine-gun dominates the modern battlefield. Fifty, moreover, does not go far to meet the needs of even our one tank brigade. Thus, for part of the exercises, the Light Tank Battalion was broken up and divided among the ordinary tank battalions. By this distribution, the 2nd and 5th Battalions of the Royal Tank Corps were enabled to have proper light tank sections in each of the three mixed companies which make up such a battalion. The 3rd Battalion R. T. C. had still to carry on with the machine-gun carriers doing duty as light tanks.

WATCHING the tank formation maneuvering, it is instructive to compare them to a fleet of land warships. But they are more truly the mechanized cavalry, or mobile arm, of an army resurrected in a new form. This resurrection makes possible the revival of generalship, infusing new life into the paralyzed arm of the modern commander. It was with this potentiality in mind that soldiers had eagerly awaited the tactical debut of the new light tank. But this year some of the higher authorities reverted to the war-time conception of tanks as help-mates of the infantry, and devised some trials on these lines. One wondered how such close co-operation would work when 30-mile-per-hour machines were teamed with 3-mile-per-hour foot soldiers. One's doubts were confirmed in the first exercise watched. In it an infantry battalion formed the advanced guard, and as soon as the commander met serious resistance he had the call upon a complete tank battalion to help him to overcome his opponents. It seemed rather like using a sledge-hammer to crush a fly, but such close combination against such a small and distributed target as an enemy battalion did not prove too easy. The fly was too "fly." By the time the commander had located his opponents they were just about to begin a stealthy withdrawal, slipping away out of touch with that ease which the machine-gun has made possible. Thus, the tanks' hammer-blow merely hit an empty space. If the tanks had gone in pursuit they would have reverted to their independent role. If they had stayed to accompany the infantry the whole operation would have had to begin afresh.

On the following day, the 2nd Battalion, Royal Tank Corps, shaking itself free of its infantry fetters that had brought its action to nullity, maneuvered over the Imber area in the first of the Tank Brigade series of exercises. There was an air of relief in the process and an impressive flexibility in its handling. Moreover, though no enemy was represented, this exercise, being merely a test of drill and maneuver, had a much stronger air of realism than the previous day's.

For it is patently unreal when a battalion of modern high-speed tanks goes "at heel" behind a battalion of foot soldiers, and is used to help that battalion forward. An infantry battalion should either be equipped to overcome opposition from hostile infantry rearguards or it has no place and purpose as an advanced guard. Incapacity for this task is a reflection on the present equipment of the infantry rather than a justification for using tanks to put them on to their objectives.

The sight of a tank battalion being used to aid an infantry battalion, or even a brigade, in taking its small steps, has the quaint grotesqueness of that favourite nursery picture, in which a tiny tot has her arms round a towering St. Bernard, holding it tight with a commanding air that deceives no one as to where power really resides.

It is unreal also when a battalion of high-powered tanks is used to strike at such a small and dispersed target as an enemy infantry battalion offers when deployed. It is the more unreal if we substitute war for peace conditions, and picture the back areas of a force—even a small force on active service—clustered with battery positions, supply columns, dumps and resting reserves. Is it realistic to expect that in the fog of war and the heat of action a "gate-crashing" body of tanks should pause to present their cards to the doorkeepers when they see such an inviting feast of targets beyond? How unwise, too, to expose themselves to uncomfortable attentions by such precise dallying. The further they get into the enemy's position, and the quicker they get into the midst of it, the safer they will be. Danger comes in breaking through the crust, and will arise again if they allow time for a fresh crust to be formed. The more one meditates on the attempt to revive close coöperation between tanks and infantry the decidedly less one likes it.

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* Author: Foch, The Man of Orleans; The Real War, 1914-1918; Sherman, The Genius of the Civil War; The Decisive Wars of History; Reputations; The Remaking of Modern Armies; Scipio Africanus—A Greater than Napoleon; Great Captains Unveiled; Paris, or the Future of War; The Science of Infantry Tactics. Captain, British Army, Rtd.

WHEN working independently, in contrast, the swift and free way in which the tanks maneuvered gave a vivid emphasis to their natural function as the heirs of cavalry. And the comparison was a warning reminder of the historical error of mixing cavalry with infantry. How often did the Great Captains condemn and correct this stultifying hybrid, sired by confused thought and dammed by overcaution. Yet how often was this error repeated! Military evolution seems condemned to travel in circles—to chase its own tail. The best hope of a reprieve lies with those who have personal experience of the possibilities of modern tank mobility.

In this respect the 2nd Battalion exercise gained value through being the first in which the new light tanks have been included in the mixed battalion. Even at this first trial they made a remarkable difference in the speed of maneuver. In carrying out the series of eleven drill movements, under the direction of Brigadier Laird, the battalion traversed about eight miles. What a contrast to an infantry parade ground! This contrast alone has a significant reflection on the idea of close coöperation between tanks and infantry.

First, the battalion advanced in column with its three companies each in trident or arrow-head formation. Next, it formed double-line ahead, then changed direction to the left and subsequently formed "two up"—two companies forward and one in reserve. At the next signal it took cover from the air among copses, and after emerging it formed a night laager. In this the transport vehicles lie in the center of a three-point formation of tanks, with an outer circle of light tanks on guard duty.

In the next phase the battalion once more advanced in column, this time in open order, the rear company sending out their light tanks to "protection stations" on the left flank. After another change to "two up," the rear company, receiving a fresh order, raced out to the right and covered this flank by occupying a detached spur.

These five movements, during which four miles were covered in a direct line and much more actually, were completed in thirty-five minutes. It is significant that a previous battalion, using the old Carden-Loyds as its scouts or "feelers," had taken fifty minutes for the same series of movements. It may thus be reckoned that the advent of the new light tanks has brought roughly a fifty per cent. increase in the speed of maneuver or armed formation. How a Zeiten or a Murat would have gloried in handling such a supermobile force! How a Frederick or a Napoleon would have profited by the possession of such a mobile arm! Will their twentieth century successors perceive the opportunity?

For in such a force lies the means, the only means, of exploiting a penetration quickly enough and deeply enough for decisive effect.

IN the last exercise of the Light Tank Battalion, before its dispersal among the mixed battalions, there was an instructive repetition of a well-remembered "battle" of two years ago. In that battle a mobile force had been set the problem of exploiting a break-through in a new "Western Front"—a problem that was never solved in 1914-1918. Nor did the 1930 effort yield a satisfactory solution. So now the experiment was tried afresh to see what difference would occur with a light tank available to pave the way for the mobile force.

The test was the harder because it took place in the enclosed country north of the Plain, where peace-time restrictions augmented the obstacle of hedges and ditches. In consequence, it was shown, as should not surprise us, that an alert defender has a good chance of blocking, or at least delaying, such a mobile force if there are rivers he can use as barricades, and if the assailant's lines of approach are fairly limited. These are conditions easier, perhaps, to obtain in peace time than in war.

But, on the other side, a significant point was brought out. While the light tanks may have difficulty in finding a passage, once they penetrate their infiltration is so rapid that the defender has a poor chance of withdrawing his infantry on either flank of the breach in time to rally and build up a fresh line of resistance to the rear. This effect, likewise, is not surprising to anyone who has reflected on the nature of modern tank warfare. For, because of their endowments of speed and armor, tanks are clearly the ideal agents of infiltration or "soft spot" tactics, i. e., to push on along the line of least resistance while reserves deal with the cut-off "islets" of the defence that still hold out.

In 1918 these tactics brought the Germans great, but limited, success, as the infiltration was carried out by slow-moving and non-bullet-proof infantry. Today it can be carried out by tanks, less susceptible to the risk of being checked by flanking machine-guns.

The possibilities of such tank infiltration tactics were again partially illustrated in a subsequent exercise carried out by the 3rd Battalion R. T. C.—an attack on an enemy's artillery area. For when the leading battery position proved difficult to capture, the tank torrent flowed on past it under cover of slope and smoke, and submerged the batteries beyond.

A DIFFERENT form of trial was staged a few days later when two tank battalions engaged in a "fleet action," disputing the command of the Salisbury Plain Sea. It was the greatest land-naval battle on record, with over a hundred "ships" engaged—battle-ships and cruisers. A Battle of Jutland in appearance because waged between grey iron-clad shapes, it was a Battle of Trafalgar in its intensity. If shells and bullets had been real the issue would probably have been as decisively settled as at Trafalgar. It only retained the indecisiveness of Jutland because of the difficulty of determining results under peace conditions.

To follow such a battle one really needs a cross-country vehicle faster than the tanks themselves; but even then one would often be baffled because of the ground craft which the tank leaders have developed. Their acquired skill in using shallow depressions and folds in the ground provided a disconcerting reminder that Salisbury Plain has not a plane surface, and that in even the most open country Nature affords land ships a scope for surprise which is lacking at sea.

Here is one dominating impression of tank warfare. Another is the amazing rapidity of action, far exceeding that of naval action relatively to the size of units, and presenting an utter contrast to the land battles of the old style. In this latest land battle the main "fleets" were over five miles apart when their approach was signalled from the air. Twenty minutes later they were pouring broadsides into each other at close range. In another twenty minutes the battle was over!

In this battle the two tank battalions were assumed to be operating on the immediate flanks of their respective armies, as "elbow-joints." The 2nd Battalion R. T. C. (Northland) had been brought up under cover of a morning mist to help

the advance of a cavalry brigade, and had been concealed in copses on the northern edge of the Plain. At 9:15 A. M. Col. Hobart received the order to push south and strike at the opposing cavalry. By 9:40 A. M., after making his plan and giving his orders, his battalion swept out from cover on its southward course. An imposing Armada, it was under far better control, not only because of motor propulsion and wireless communication, but also because of team-training.

On the Southland side, the 5th Battalion R. T. C., had been brought up before dawn and concealed from the air, ready to intervene if its own cavalry were attacked by enemy tanks. If such a tank advance was reported, the 5th Battalion was to move out and engage them without waiting for further orders. In taking prompt action to meet the menace, Lieut. Colonel Tilly was helped by the fact that his air observer happened to be a seconded Tank Corps officer. Two minutes after the Northland tanks moved out the Southland airplane flew down their line with wing-tip flares lighted, showing by this heavenly signal their direction of movement. It sufficed, although supplemented at 9:50 and 9:55 by more detailed messages. Already Lieut. Colonel Tilly, forward himself near the observatory, had called up his other companies. One of them, indeed, too instinctively adopting a well-practiced maneuver, swung out in an outflanking detour instead of coming direct, and so missed its own commander. But team-sense retrieved the misadventure, and, "marching to the sound of the guns," with greater speed than the Prussians of 1870 could manage, it was able to join in the battle.

Meanwhile, the two "battle fleets," after a preliminary clash between their light cruiser-tanks, had met. Running on parallel courses, they opened fire at about 1,500 yards range. The Southlanders, opening first, gained an opening advantage. But the Northlanders retorted with a clever trick. Dropping out of sight by a somersault-wheel down a slope to the westward, rather like the Germans at Jutland, they came back and "peeped" their guns over the crest. Thereby they gained the advantage which well-aimed stationary fire offers.

The battle moved on. Leaving one company locked in a death-grip with one of the enemy, the leading Northland company swept on southward. The other two Southland companies converged upon its flank, and a fresh maelstrom arose, with a Southland advantage. But Northland still had a reserve company—under sure control. Coming round in a circular sweep, this intact and solid reserve descended on the tail of the "dogfight." Its bite would have been incisive, and perhaps decisive. For in tank battle the value of "the last reserve" is likely to be even greater than in Napoleon's day.

A tank v. tank battle on such a large scale as this undoubtedly provided valuable experience. But it must be viewed in true perspective, as an eventuality rather than a probability, still less a desirability. For any commander possessed of such a potent "piece" as a tank force to throw it away in fighting the enemy's tank force would be foolish in most circumstances. And the more foolish if an army possessed only a single tank brigade.

To do so might be justifiable for the weaker side, purposing a prolonged defensive, trusting in a static defense, and having the natural obstacles for such passive resistance. But outside this rare case, any army would be wise to preserve its tank force for purposes more profitable than merely cancelling its opponent's assets—by mutual suicide.

A more probable type of tank v. tank battle than this Jutland on land was seen in an exercise where the 2nd Battalion R. T. C. made a raid on the enemy's Army Headquarters, to whose rescue the 3rd Battalion R. T. C. was called. While it would be foolish save in an exceptional case to waste tanks in cancelling tanks—to "swop" these queens of the military chessboard—it would be more natural for the higher command to use their tanks to avert such a menace to their brain-box. Especially if one takes account of human nature.

BUT when one saw the problem that Colonel Hobart of the 2nd Battalion was set, one felt that the difficulties in this case were the exceptional fact. A fact that made the result all the more significant.

Simultaneously with a general offensive by the Southland Army, the 2nd Battalion R. T. C. (with a light company attached) was to swing round the eastern flank of the Northland Army and attack its headquarters, as well as its supply columns, at Tilshead.

Colonel Hobart's lines of approach to this objective were restricted, not only by blocked crossings immediately behind the flank, but also by an imaginary lake just south of Tilshead. Thus he was reduced to an approach from due east or a circuit to the north-west. More restrictive still was the fact that the Northlanders had both a tank battalion and a special battalion of seventy-two mechanized antitank weapons at hand for the defense of their headquarters. Such a battalion only exists on paper, but this imaginary property counts as real estate in peace maneuvers, and so was formidable.

Examining the problem Colonel Hobart justly discarded the course of making a direct approach under such cramped conditions. With equal wisdom he discarded the idea of a wide circuit round by the north as too obvious. If spotted from the air, as it must have been, the enemy would have time to forestall it.

Hence he decided to move by night to a central position east of the Avon, and to debouch from cover in the morning, cross the river, send out his light company on the widest possible front to probe the enemy's dispositions, and then thrust at weakness.

He was, clearly, following the Napoleonic method.

THE tank battalion commander on the other side seemed to have most of the cards in his hand. In the first place he knew his adversary's objective. Secondly, he was in a central position. Thirdly, circumstances prevented that adversary having a 360 degree choice of approach, and reduced him to a merely 90 degree range.

Fourthly, to defend this quarter-circle he had not only a tank battalion himself but the aid of a company from the antitank battalion. This gave him a marked superiority in armor-piercing weapons.

The one real handicap was a difference in mobility, due to the fact that the defending 3rd Battalion was provided with the latest light tanks. The disadvantage was much greater than it sounds. The difference it created in the exercise startlingly reveals the change that pure speed can make in offensive power, and the way that tank mobility is altering the normal conditions and calculations of war. For it was shown that it may not only redress a disadvantage in strength but over-balance superior strength.

In weighing up the problem the defending commander, Lieut. Colonel Broome, had taken account of this difference

in speed. His plan was to create as wide a barrier as possible with antitank weapons and land mines, to lure the attacker across this deadly zone, and then to counter-stroke him from a favorable position. In addition, his hidden antitank weapons were ordered to keep silent until the enemy's light tanks had passed through them, and thus catch the medium tanks unguarded and off their guard.

The plan was cleverly conceived. Two antitank platoons were put out to the east, with the third in reserve on the northern flank. Land mines were laid in two layers, 600 yards apart, across the most likely valley leading to Tilshead from the north, and some also on the ridge. Yet this web was pierced.

At 10:30 A. M. Colonel Hobart sent his light company across the Avon. It moved in three wide-apart "prongs." Within three-quarters of an hour the southern prong had located the enemy's southern antitank platoon. Colonel Hobart at once decided to swing right round by the north. Moving by valleys he reached a point about five miles N. E. of Tilshead. Thence he dispatched a company directly towards the flank of the enemy's defense—as a distraction. Its nimble and unobtrusive light tanks, after one had been lost to a mine, cleared a path through the screen of antitank weapons. But then, pressing on, the company was trapped and crushed between two hostile tank companies just about noon.

But if this move was costly as a feint it was profitable as a distraction. For the moment it had drawn the enemy's attention. And during this brief abstraction the rest of the 2nd Battalion had slipped into Tilshead, at 12:25 P. M. Such is tank mobility. Cleverly using trees and valleys as cover, Colonel Hobart had swung further west and come down from the north. He was observed by a patrolling enemy light tank, but the latter's Verey light signals were not observed by those behind until just too late.

Lieut. Colonel Broome, indeed, had recovered from the distraction very quickly and, growing suspicious, had rushed two companies back towards Tilshead, where they would at least have made the attacker pay dearly for his success. So quick a reaction is rare in war. Hence its failure is the more significant—as evidence of the advantage that tank mobility gives to him who has the initiative, and of the difference that a difference in speed makes.

AFTER sharpening their claws in battle against one another, the tanks turned next day to a simpler test—that of rending a marching column of infantry. They executed judgment with remarkable celerity. At 9:30 A. M. a wireless message informed Colonel Hobart that an enemy infantry brigade had been seen from the air marching southeast across the Plain to reinforce the enemy already engaged with his own infantry near Stonehenge. The 2nd Battalion R. T. C. was told to delay this fresh brigade, so as to prevent it tilting the scales of battle. When this urgent call came the tanks were lying up under cover five miles distant from the head of the enemy column. The latter had a less distance to go before it would arrive on the field. But it did not arrive.

By 9:55 A. M. the tank battalion was on the move, already preceded by an officer's patrol in light tanks, reconnoitring for the head of the enemy column. By about 10:15 A. M. this head was first smitten and then riven by the ever closer fire of the leading tank companies. Soon after 10:30 A. M. the whole body had been dealt with.

The problem was complicated rather than simplified by the operation having to be made on an almost invisible body. It recalled stories of perplexed doctors being asked to treat Indian princesses under conditions of strict purdah. A trained as well as a vivid imagination was needed to picture the white strip of road filled with the marching mass of an infantry brigade and all its horse transport. Even the flags and screens which represented its protective weapons—a field battery, a light battery, and sixteen antitank machine guns—did not adequately fill in their part of the picture.

If the opposition had been real the task of the tanks would have been eased rather than aggravated. This was evident when the tanks exposed themselves. It was not easy for the tanks to see their "opponents" or to see when they were being fired at. And it was still less easy for an observer to say when and where this imaginary mass of infantry, inevitably thrown into confusion, would have got in the line of sight of their own scattered antitank weapons and blanketed them. In such imaginary conditions it is more instructive to study the method than the manner of the tanks.

THE method of the 2nd Battalion was essentially to get inside the enemy's guard as soon as possible, and to keep inside it as far as possible. The commander sought, so far as conditions allowed, to follow his tactical policy of making his attack in the area most favorable for tank movement, and of concealing his line of approach. From the most commanding observation point on the enemy's line of march there was no sign of the tank battalion's line of approach until it suddenly appeared about 2,000 yards distant, moving up a shallow valley. As this had a rather unfortunate straightness, the tanks, concentrated for cover, momentarily offered a concentrated target to the couple of light howitzers which could observe their approach. But it is well to remember that in war the "target" would certainly have dispersed when the first shell fell. And from this moment on the inadequacy of the antitank defense, necessarily spread out to cover such a long column as an infantry brigade forms, became more and more apparent.

The two leading tank companies struck into the column and swept it up in scooplike fashion. And their formation was like a scoop, the innermost medium tank of each company close to the edge of the road and the others echelonned outside and ahead of it. The light tanks went ahead of the mediums and further out, ready to nip in the bud any antitank weapons which emerged from the columns and tried to open fire from the roadside. After the "scoop" had travelled some distance up the column a section of enemy field guns was seen out on the right flank. The right company of tanks swung out to take it in rear, in such a way that even if the guns turned in time they could hardly fire for fear of shooting into their own troops. Meantime the reserve company of tanks, already warned that enemy tanks were suspected to be in the neighborhood, had diverged from the others, making for Ell Barrow, the highest ground on the right or near flank, whence it could intervene as required at the earliest moment.

A fresh problem soon developed—on the director's inspiration. For the scooping up of the enemy infantry was interrupted by an air report that enemy tanks had been seen to the south. It produced an instant answer. Within ten minutes of the message the whole tank battalion had rallied, reformed in "trident," and was ready to deal with this new opponent. Such quickness in reorganizing offers a remark-

able contrast to the older arms. It is the product of the new tank team work, no less than of tank mobility.

As regards the method adopted by this battalion in attacking infantry it was evidently based on a principle which one may express in the motto, "The deeper, the safer." It seems to me to have much wisdom, especially if one's imagination can people these empty spaces with all the crowded troops and transport of war.

The 3rd Battalion which carried out the same exercise previously, tried a different method. After light tanks had drawn the enemy's fire, the two leading companies cut across the head of the enemy column. Then, rallying they turned and struck across it again from the far side, while the reserve company converged upon it also from the near side. Such a method certainly provided that manifold distraction which is so important, especially in the approach to close quarters. The only question is whether, later, by going outside the enemy's guard again, he might be able to redistribute his antitank weapons again ready to meet the next stroke.

Time is the essence of the problem, and here tank-time is so quick that such redistribution is difficult. Perhaps the best answer is that both methods should be practiced, keeping the enemy in uncertainty. If an army has a fixed doctrine an enemy is better prepared to meet it. One would also suggest that the deep-in scoop may pay best if the enemy is early thrown into confusion, while the profit of the criss-cross cut may depend on how far the enemy's antitank weapons are mobile.

AFTER a day's interval the exercises rose in scale. One of the most impressive was when the whole Tank Brigade, some two hundred tanks in all, swept across the Plain in a wide-sweeping maneuver, controlled by a single voice—that of Brigadier Laird.

First we saw this great armor-clad array massed on the edge of the high plateau above Warminster. It embodied a fire-power—in guns and machine-guns—greater than that of a whole infantry division of nearly 20,000 men. That fire-power is for practical effect multiplied by armor and speed. Yet it could be assembled, as we saw, in a space that was not a tithe of what an infantry division would occupy. More significantly still, that tremendous fire-power was wielded, that land-Armada manned by hardly more than 600 men!

If battles are won, as the pundits are always repeating, by the concentration of superior force at the decisive spot, certainly no other type of formation can so concentrate its force at a spot as a tank formation can. And in modern war force is a question of fire-power. Further, the conditions of war are still such that fire which is directly applied at close ranges—as the fire of an armored force can be—is far more potent than indirect fire, in battlefield reality.

In this scheme the Tank Brigade was the mobile arm of maneuver of a Southland Army. In front of this the Northland Army had been retiring, and its rearguards overnight had halted on the line of the little river Ebble, just south of Salisbury. During the night the Southland Army commander sent off the Tank Brigade with the aim of turning the enemy's steady retirement into a rout. His air reports before dark had told him that all the main roads leading northward were much congested, and, in particular, that an enemy infantry division was bivouacked in depth along the road from Salisbury, ready to resume its march in the morning. Before it could pounce on this fat prey, the Tank Brigade had to get round the enemy's flank. But tank mobility provides the means of circling round such barriers swiftly. So by daylight next morning the Tank Brigade had reached, and was concealed from air observation on, the heights above Warminster. No aircraft were available to reconnoiter for the Tank Brigade, so it had to depend on its own light tank battalion to discover the enemy's whereabouts as well as his detailed dispositions. This inevitably meant some delay, but it was a practical test.

At 10 A. M. Brigadier Laird issued his orders for the approach to the enemy's suspected line of march. Behind the fast-moving steel curtain of the light tank battalion the rest of the brigade was to advance in two columns. The light tank battalion was to make its first bound to the line of the road running north. Eleven miles distant, this would have been nearly a day's march for an ordinary division. The second bound, if required, would be to the Avon, another five miles; and the third bound five miles beyond.

At 10:30 the light battalion moved off, with the three mixed tank battalions hard on its heels, a necessary closeness in starting because of the relatively slow speed of the old Carden-Loyds in the mixed battalions. What a strange contrast there is between these squat toad-like machines and the new light tanks. As the latter moved off in line ahead or single file, with their tapering wireless masts standing up above their high and narrow turrets, they appeared, when a few hundred yards distant, to be a column of mail-clad lancers. One was transported to the age of chivalry.

When the mediums moved off in turn, one's picture was changed to the sea. The least imaginative onlooker was presented with a perfect picture of "the Grand Fleet in the northern mists"—an impression deepened by the thick mist which enveloped the rolling Plain and turned the green slopes into grey waves.

Soon in the far distance the tanks appeared suddenly out of a valley, and caught one's eye as they crossed an open slope. The picture changed again. For it was exactly as if one had switched on the light in a cellar and seen a swarm of black-beetles scuttling to cover.

By 10:55 the light tank battalion had advanced over seven miles. Here came an inevitable check in passing through the bottle-neck from one training area to another. Yet before 11:30 it had made contact with the enemy's marching column. And from 11:35 A. M. to 11:50 A. M. a stream of messages reached the distant brigade tank in rear, giving the location not only of the head and tail of that column, but of its battery positions and antitank weapons. The light battalion then rallied, ready for further tasks. The accuracy of this reconnaissance was as remarkable as its quickness, for some 90 per cent of the locations given were correct.

At 12 noon Brigadier Laird was thus able to give orders for the 5th and 3rd Battalions R. T. C. to cut up the forepart and hindpart respectively of the enemy column, having sent off one light company ten minutes earlier to block the head. At 12:40 began what recalled the description of Polybius of the Roman pursuit after Ilipa—"a slaughter as of sheep." At 1:05 P. M. the 2nd Battalion followed by the remaining two light companies, was launched through the gap between the first two battalions to extend the enemy's disorganization.

On the following day the Tank Brigade disappeared from Salisbury Plain into the depths of Dorset. Thence, after a night's halt, they reappeared to provide a still more extensive object-lesson in the mobility of armored force, and in its true

use as new-style independent cavalry—the strategic striking arm. Directed in a long-range maneuver wide round the flank of an enemy army against that enemy's communications, they covered nearly fifty miles. By the afternoon they were astride the enemy's rear and were "still going strong" with new-style Johnny Walker strides.

YET the first part of their route was through devious Dorset byways, steep and narrow. Such a route they would certainly not meet in most of the theaters where the British Army might be called on to operate. And their speed had to be reduced to suit civil conditions, which would be swept aside in war. On these narrow roads, bordered by high hedges, civil traffic offered a frequent impediment. And equally hindering was the care that had to be shown in navigating the villages and country towns on the way. In war, with time of supreme importance, speed would not be reduced to avoid the chipping of garden walls.

Even as it was, the Light Battalion, moving ahead like a steel-curtain, had secured the crossings of the Wylye at Warminster by 9:40 A. M. Its left company had covered the 29 miles from the bivouac near Blandford in just over three hours, despite these obstructive conditions and the extra one of armed interference from enemy armored cars. The right company, which moved by still more devious but less civil-obstructed lanes and tracks, gained the crossings at Heytesbury even earlier. The mixed battalions of the brigade also moved in two columns, the 2nd Battalion on the right, and the 3rd on the left, with the 5th Battalion following the latter. The head of the left, or main column, reached Warminster 3¾ hours after its start. One may safely gauge that, under war conditions, the average speeds would have been half as much again, and could at a pinch have been doubled.

No organization is more liable than an army, as all experience shows, to miss the wood for the trees. Attention is so easily focussed on facts and figures of performance which, though of real help to improvement, are an unreal basis for judgment because of the inevitable unreality of peace-time conditions. In this maneuver the obstruction of civil traffic and peace-time property restrictions was so marked as to diminish the importance of the time data. The day before, on straighter roads, more like the typical roads of the Continent, but still strewn with civil traffic, the light tank battalion had averaged approximately 14 m. p. h. for the move to the bivouac. The mixed battalions with eight-year-old medium tanks and under-engined machine gun carriers doing duty as light tanks, had averaged about nine miles per hour. "Casualties" were remarkably low, in view of the age of the machines and the hard trial they had undergone during the continual exercises of the past two months. This is high testimony to the standard of maintenance and mechanical training attained by the Royal Tank Corps, if it is the more reason for providing them with up-to-date machines.

The broad significance of such a tank maneuver is best perceived by reference to some actual case—from historical experience. Such a case was furnished by this "scheme," with its striking parallel to the 1914 campaign. When the British Expeditionary Force stood at bay, first at Mons and then at Le Cateau, the possession of a tank brigade such as we saw here, and its ability to carry out a maneuver of this radius, would have enabled us to cut the communications of Von Kluck's attacking army. This could hardly have failed to save our army from the peril it stood in at Mons and at Le Cateau, from which it only escaped in 1914 at the price of an exhausting and costly retreat.

Take, again, the Battle of the Marne. This maneuver by the Tank Brigade would have taken it right round the flank of the Germans and astride the rear of their right wing. With our knowledge of the "loosening" effect of a far shorter-range flank move by Maunoury's army in September, 1914, it is easy to gauge the collapse of the German right wing under such a stroke.

Take the sequel to the Marne, the so-called "race to the sea" after the Allied pursuit was blocked along the Aisne. Over a week passed before the Allies were able to develop a turning maneuver, and the Germans had ample time to block it. Twelve days elapsed before a second attempt could be made, further north near Arras. It proved similarly futile. The third attempt, by the British II and III Corps between La Bassée and Messines, took another nine days in delivery, and was abortive. A fourth attempt by the British I Corps at Ypres, a week later, was not merely a failure, but found the Germans ready for a greater counter-offensive.

Yet in each case a single day's march by a tank brigade if available would have carried it right round the flank and on to the rear of the Germans—as they were placed on the day after these old-style turning movements were ordered. Such is the difference between maneuvers in tank-time and in old time. Tank-time is the correct time for marching to a decisive spot. It gains time so quickly that it can gain a decision. And it is the only rate of maneuver which has such a promise in modern warfare.

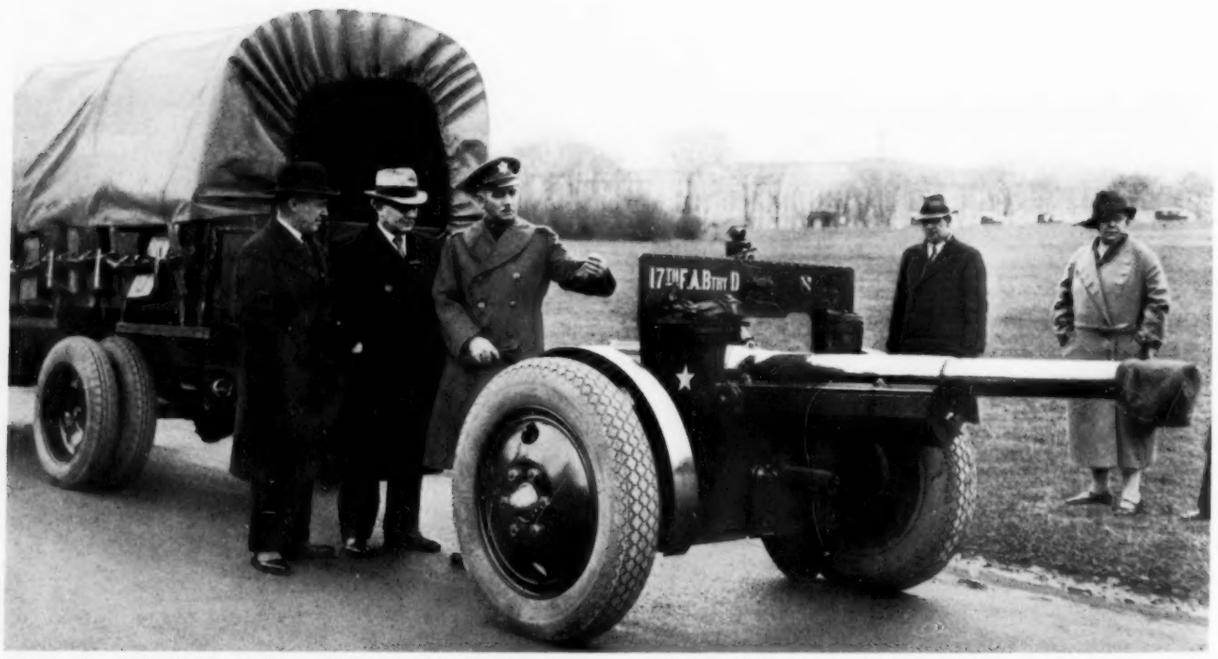
BUT there is another significance in this reproduction of history. Shallow critics often refer portentously to the problem of supplying what they term a "mechanised army"; and imply that it would be so formidable as to make mechanisation a hazardous leap in the dark. Now in actual fact a tank brigade or brigades could have completed any of these incomplete 1914 maneuvers, and have returned to their base (with the main army) if necessary without any transport at all. For the medium tanks carry enough petrol to take them well over sixty miles out and back. And food for the tank crews can be carried far more easily in the tanks than the great cavalry raiders of the past carried it on their horses. These modern armored cavalry are, indeed, so much better fitted for moving without the impediment of transport that it might be well if they were accustomed to do so.

Even if a maneuver of double this radius (i. e. 250-300 miles) was required, a mere twenty petrol lorries would suffice to refill the whole brigade. What a contrast to an ordinary division, which includes some 740 horse-drawn vehicles, apart from the 360 motor vehicles which are needed to bring up its supplies, baggage and ammunition as it is crawling along at a fifteen-miles-a-day rate! In face of such facts current talk of the difficulty of supplying a tank force seems pure "hot air." But it is not often that an out-and-back journey of 250-300 miles would be required to reach and cut the enemy's communications.

Let us take once more an actual case. If in 1914 the British had possessed a tank force, and had landed it at Antwerp, a move of barely sixty miles would have carried it to the Meuse, and placed it astride the communications of the German Armies that were marching through Belgium. It might have made the Battle of the Marne superfluous, and have saved the four years' occupation of Northern France.

Newcomers in the Family of Mechanized Equipment

The Low Winged Bomber of the Army Air Corps at the National Air Races at Miami.



Battery D, 17th Field Artillery, Displays its Modern Equipment in the Nation's Capital While Enroute to Vermont for Exhaustive Winter Tests.

The Munitions Picture in Detail

A Method for Stimulating Industrial Preparedness

By Alex Dow*

TO me it is an honor to be asked to speak at this meeting. I am a new man in Ordnance. A little about that subject—a very little—I have known since early youth—enough to let me recognize at Gibraltar a Woolwich, seventy-one ton, muzzle loader of the 1870 style when I set my eyes on it some fifty years after its production. But not the long string of disconnected facts which have remained in a memory adept to fasten on unrelated items of knowledge; nor my much interrupted studies of the last nine months since I was named as Chief of the Detroit Ordnance District—neither of these qualifies me as competent to instruct an audience like this, which knows the subject better than the speaker. I assume that I am *supposed* to be worth listening to. I hope so. If so, it is because my views are still fresh and in the formative stage, having interest, if not value, because of novelty. They cannot be entirely novel because ordnance is a subject which began to be discussed when men first went out to war, many millenniums agone.

There is another possibility. I am a member of a certain club of literary habits. A practice of that club is to make the latest addition to its membership provide the speech of the evening for the annual meeting first after his election to membership. The results of this long-standing custom are sometimes good, sometimes mediocre, and often just plumb funny. If the invitation to me was a following of such a custom, you must lay the blame (or the credit if there shall be any) on the heads of the powers who gave the invitation. Blame or credit disregarded, I am none the less honored.

To me, coming newly into the picture, it is evident that the problem before me is to obtain the intelligent and willing and interested help of the manufacturers in my district, in preparation for the conditions which may be spilled upon us by the next involvement of the United States in an international dispute. You will observe that I have no hope of perpetual paths of pleasantness for our beloved country. As a well-drilled Episcopalian, I respond devoutly at the proper time in the Litany, to the petition which says, "Give peace in our time, O Lord!" But I have a mental reservation in saying the response, which runs—"Because there is none other that fighteth for us but only thou, O Lord." I think the syllogism is incomplete, because God helps those who help themselves. One of our national mottoes alike needs amendment—that motto which reads, "In God we trust." The amendment could be well put into the words of old Oliver Cromwell, who said to his Ironsides—"Trust in God, but keep your powder dry."

AS a student of history, I observe that the United States has never gone into a man-sized war in a state of preparation for the war. We have jumped in, splashed both ways, and ultimately come through. We have worked magnificently, with the result that at the end of each war we are excellently well prepared for the beginning thereof. The unreadiness has been costly, always in money and sometimes in life and limb—but what's the use of saying this, you all know it!

I spoke only as a preliminary to putting before you a method, which, if acceptable, should help my work and perchance that of other chiefs of ordnance districts. Thus: to get the intelligent interest of possible makers of munitions towards war preparations, you must stop talking generalities. You must make a picture of a definite possibility, with quite a bit of detail. You cannot ask a manufacturer, or his chief production man, to study a problem which runs this way—(a) there may be a war; (b) if so, the United States will want munitions; (c) you will be asked to make munitions; (d) the quantity, quality and even the character of the munitions to be called for are indefinite and will not be settled until the war is on top of us; and lastly—what are you going to do about it? To speak thus is to invite an answer, presumably polite, but certainly evasive.

My thought is that we must go at it by presenting a picture of a possible war. We must needs leave names, places, and dates out of the picture but we must make the picture interesting. We must set up our stage scenery. It does not so much matter what the setting is, as that it shall be possible and without contained improbabilities. Avoiding infringement on the assigned duties of the War College, and the General Staff, let us take a look at the several possibilities and pick out one which will serve the purpose of making such a picture.

IN what sort of a war is it conceivable that the United States may at some time hereafter become engaged? A border war; a war of enveloping and wiping out an invading force which has lodged itself within our boundaries; a war such as the last, in which our program, happily terminated by the Armistice, contemplated the service over-seas of several millions of American soldiers; or will it be a little expedition of a few thousand men to discipline some distant aggressor, or possibly to intervene between foolish combatants to protect our own interests, or save the peace of the world? Of these possibilities, the latter is the most likely. It may happen any year. We should hardly call it a war. We should probably name it an expedition, and it would not in its beginning constitute an ordnance problem. But if it were multiplied, say, ten times it would be a war, so let us assume the multiplication.

Let me say a word or two about each of these pictures. There are two land borders to our home land, the northern and the southern. A border war on our northern frontier is inconceivable. Even a technical state of war would be equally inconceivable were it not that the Dominion of Canada is now one of the self-contained, self-determining nations of the British Commonwealth; and that its attitude towards us might become adverse because of troubles having their origin and their development elsewhere in that Commonwealth. Even that condition, *de jure* but not *de facto*, is broadly improbable, and it is not worth while to make a song about it.

As to the southern border—that is a different story. Remembering the Vera Cruz expedition, and the recurrent

* Chief, Detroit Ordnance District. An address delivered at the Fourteenth Annual Meeting of the Army Ordnance Association at the Union League Club, New York, December 21, 1932.

instabilities of government on the other side of the Rio Grande, there is a historical possibility of warfare. But it will not be a border war. That border is not a good one for a war. There will be patrols on the border. There will be raids and retaliations. There will be no large warfare, unless as the cleaning-up of a much larger war, having its main location elsewhere. You will recall the efforts made to provoke Mexico against us during the World War. Any dispute with Mexico alone is likely to be settled diplomatically. If a show of force should be necessary, a compact expedition aimed at a vulnerable point not on the border would be the most likely form of action by the United States.

We have two ocean frontiers. These are in the first place the business of the Navy. That they might be raided, in these days of airplane carriers and submarines, is a military possibility. That any extensive lodgment of a hostile force could be made on either seaboard is a picture which might be worth painting, with intent to encourage our development of coast artillery and antiaircraft guns; but it does not at the moment appeal to me as a good picture to paint for my immediate purpose. And in disposing of the question of war upon our ocean borders, I have disposed of the second of my suggested types of war—the wiping out of an enemy force which had made a lodgment.

THERE remains the possibility of a compact expedition sent overseas—not a mere police detachment, but a hundred thousand men, or two hundred thousand men. That picture looks as if it might be a useful exhibit. It is possible, and it can be talked about without naming names or casting aspersions against a possible enemy. The destination might be on any of four continents. The occasion would be defensive, in the sense that the best defense is always an active attack. Of course all wars are *by description* defensive. Even if a war has been planned and prepared and provoked, the provoking nation will proclaim that the attack was made by it in self-defense; but this is no place for dialectics. I shall assume that some day or other a United States government, with public opinion handsomely behind it, may find it expedient to send two or three or four Army corps across seas; and that the original equipment thereof and the ordnance service to that expedition must needs be effective and continuous; in every respect a credit to ourselves as a rich and wise nation, and in every item an aid and security to our sons and grandsons who are sent. My suggestion is that we may obtain the desired District interest and personal good will by setting up the picture of such a war, of what it would mean in the way of equipment and war material, and of what would be needed from each of our respective districts.

There is more merit to the suggestion than its helpfulness towards the solution of an Ordnance Department problem. That United States preparedness should be readiness to strike anywhere, with such an expeditionary force as I have described, is a proposition which can be bounded and measured financially and technically. If this meeting had a different purpose—if its purpose were to educate ourselves and our executive and legislative authorities towards a desirable ideal—I could offer you historical references aplenty, going back into Hellenic history and arriving in due sequence at the original British expeditionary force of some 150,000 men, which gave good account of itself in the early days of the World War. That force was not adequately armed. No single weapon was as good as the best available. But it was consistently equipped and was trained to use its equipment; it was well-balanced; and as a unit adapted to mobile warfare, it did, as I say, give a marvelous account of itself.

ASSUMING for the moment that you accept my suggestion as worthy of thought, let me ask whether the equipment within the United States would arm such an expeditionary force as it ought to be armed. Our answer must be—no. We would wish to put into effect all the lessons taught to the military world at such terrific cost by the World War—the lessons which demonstrated the place of the machine gun, of the automatic rifle, of high-angle fire of field guns, of improved shells and shell charges. To elaborate this answer would lead us into questions for the War College. Nevertheless I must have an answer to the questions of those who are (in effect) my clients in the Detroit Ordnance District if I am to have them visualize the place which they might take in the picture. Of course if I were called on to keep our Army supplied with obsolete material, I should carry on. But I should feel about it as certain British munitions manufacturers did, to my knowledge, when continuing to make shrapnel for the British Army while knowing that high explosive loadings should long before have been substituted.

Again going a little outside of Ordnance Department matters—would the force, constituted as I described it, and equipped as we would want it equipped—would it be a useful *defense* for the United States? The answer of course is that standing alone, in the face of the existence overseas of such a war as that which ended fourteen years ago, the mere ability to equip and maintain such an expeditionary force would not be sufficient. There would needs be reserves back of it, and provision for great increase. There would needs be home-trained and organized troops to take the place of the departed expedition. There would needs be developed beforehand the four divisional training areas which are ready to our hand. There would be coast defenses, and there would be the best coast defense of all—namely, an adequate Navy. Listen now to what Gouverneur Morris wrote in 1794 to the then Secretary of State. His letter went into a department file a century and a third agone, but its intent is equally valid today.

"I believe," he wrote, "that we could now maintain twelve ships-of-the-line, perhaps twenty, with a due proportion of frigates and smaller vessels. And I am tolerably certain that, while the United States of America pursue a just and liberal conduct, with twenty sail-of-the-line at sea, no nation on earth will dare to insult them. I believe also, that, not to mention individual losses, five years of war would involve more national expense than the support of a navy for twenty years."

Translate Morris' twelve ships-of-the-line into a mobile force of 120,000 men, and his "perhaps twenty ships" into 200,000 men completely equipped and thoroughly trained, and the words written in 1794 are good in 1932. But all of that is another story and this is not the occasion for its telling.

I have thus made my offering. I have outlined the picture, which I desire during the coming year to paint to the industrialists of my district. I will have to be guided much by expediencies—that is to say, I will not try for things that are evidently out of my reach; and this presentation to you at this time is at most my notion of how to try for education; to picture such a war as might arise; to show the makings and the equipment of such an expedition as I have outlined; and to show my local friends how they might aid in a righteous adventure. And further at this time deponent sayeth not!

ARMY ORDNANCE

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Month by Month

ANOTHER thrust under the belt was delivered the national defense with the passage of the arms embargo legislation in mid-January by the United States Senate. Fortunately some members of that august body were caught napping and they have requested that the matter be reconsidered. At this writing reconsideration is expected at an early date. Every believer in a sound national defense doctrine will hope that such an academic gesture of decidedly harmful effect will be rescinded.

An Embargo on Arms

It is interesting to recall the history of this allegedly peace-promoting move. It dates back to 1919. In that year an arms control convention was signed by twenty-eight countries including the United States. The instrument was not approved by the United States Senate because it placed administration of the pact principally under the League of Nations. In 1925 the proposed convention was amended to avoid the former objection by placing the responsibility of enforcement largely upon the sovereign states and by making publicity for armament transactions an important feature. The amended proposal was submitted to the Senate in 1926 but has never been approved. There is in effect, however, a joint resolution of January 31, 1922, which provides "That whenever the President finds that in any American country, or in any country in which the United States exercises extra-territorial jurisdiction, conditions of domestic violence exist, which are or may be promoted by the use of arms or munitions of war procured from the United States and makes proclamation thereof, it shall be unlawful to export, except under such limitations and exceptions as the President prescribes, any arms or munitions of war from any place in the United States to such country until otherwise ordered by the President or by Congress." Under this legislation the Executive has the power to declare arms embargoes against China and Latin American countries in cases of revolution and other domestic violence. The limitation does not apply to international war.

The present legislation if enacted would extend the existing authority of the Executive to declare embargoes on the export of munitions to all nations at war provided "special undertakings of coöperation can be secured with the principal arms manufacturing nations."

The reasons why the proposed legislation is inimical to the national defense are not hard to find neither are the ways and means of circumventing the device itself. The jeopardy to our own defense being the more important, we will discuss it last. It will not require the mentality of a technocrat to figure out what the real effect of the proposed embargo will be. Let us put the case in primer fashion in order that the charge of involved expression justly leveled at technocrats may not apply. Suppose the world-wide embargo legislation is in effect and countries A and B feel that there is trouble ahead between them. Now let us suppose that there is a broomstick manufacturer in the United States whose product is especially to the liking of A who knows that after hostilities are declared there will be an embargo. The answer: A will lay in a stock of cudgels while the getting is good. In fact, a wise A will stock up on two or three times the anticipated requirement. So instead of preventing a threatened conflict the embargo may help to bring it on. At least there is the possibility that it will stimulate trade in American broomsticks and even more intricate weapons in peace time, a condition in itself not to be condemned from the standpoint of American industry.

As to the jeopardy to our own national defense an observation decidedly more to the point is appropriate. Unless we as a people, who have already had our finger tips burned badly enough, are going to set-up ourselves and some of our friends as the guardians of the peace of the world through the instrumentality of this type of boycott we are battering our heads against terrific odds. As Will Rogers puts it and as we have quoted before in these columns, "You can't convince a fellow not to carry an umbrella if he thinks it's going to rain." In reality any individual who is so minded will take the best substitute for an umbrella in case of a shower. With people as they are why then should anyone by agreement stifle whatever small buying there is in America particularly when this business is in reality an educational order for munitions. It has been pointed out quite accurately that "an embargo without coöperation would tend to give an advantage to a nation which permitted shipments of munitions since the latter's potentiality for manufacture would be increased." That potentiality is munitions-producing power. The fostering of that power is the great contribution of the mid-twentieth century to military defense. To further it in a limited way we have been urging "educational orders"—a much desired but an unaccomplished fact. We have never had educational orders for American munitions financed as other "self-liquidating" projects are and there is slight opportunity of getting them now—except insofar as any materials produced by manufacturers in this country for foreign purchasers are concerned. In reality these are our only educational orders and their value to our "potentiality for manufacture" is, in our estimation, a far greater contribution to world peace than any embargo by agreement will ever be. Our concern then is from the educational order standpoint. One cannot preach an embargo in one breath and in the next sponsor educational orders. They are contradictory in terms.

The attack on American munitions is so insidious, the plans concocted by amateurish peace advocates are so grotesque—

in a word, the schemes of some of our specialists in foreign affairs are so blatently anti-national-defense that one begins to wonder whether our own interests come first. They most certainly do not and will not if this arms embargo absurdity becomes a national policy.

The A. O. A. in Meeting Assembled

THE Fourteenth Annual Meeting of the Army Ordnance Association as described elsewhere in this issue was more than a departure from the type of meeting which has been held by the organization since its establishment. While it was a matter of regret to forego temporarily the usual gathering of our members at the Aberdeen Proving Ground to view and study the newest types of weapons, it was nevertheless a happy thought which prompted the substitute meeting.

The presence of and the address by former Secretary Baker are high lights in the history of our fourteen-year-old society. Endowed with a leadership and record of service which few other men in public life in America possess, Secretary Baker by even the play on "adapters and boosters" which opened his address, showed his intimate understanding of ordnance problems of the World War. Likewise the presentation of Mr. Alex Dow, the comparatively new Chief of the Detroit Ordnance District, revealed in the robes of an ordnance leader one who is otherwise well known for his ability as a speaker and analyist on engineering and industrial topics.

Add to this the presence of two of the Association's medalists, General Rice and Colonel Scott, who are renowned for their energetic handling of great munitions problems in time of war, and we feel that the scope and purpose of the 14th Annual Meeting are significant.

It was a matter of keen regret that Brig. Gen. C. L'H. Ruggles was not able to be present to accept the medal which was awarded to him, and it is the hope of the entire membership that he will soon enjoy good health.

The recurrence of these annual functions whether in the form of the Aberdeen "show" or of the more formal gathering as in New York cannot but revive among friends of ordnance preparedness a sense of pleasant responsibility. Often in the past attention has been called to the novelty of industrial preparedness as a major component in our scheme of national defense and, simultaneously, of the unusual meaning of our organization in that plan. There were some who in the early days of the Association looked upon it entirely as an organization of men who had served together in the World War. With the growth of the industrial preparedness doctrine and an understanding of its lasting importance the complexion of the society took on broader aspects so that today it is in fact the nucleus of industrial and military men upon whom industrial preparation for war of the future will rest. That such a condition has come about is of more than passing interest. The new technique of national defense has demanded a new approach and the 14th Annual Meeting of our Association will go down as a definite indication that the industrial aspects of the World War are not forgotten and that the same phases of any future war are being given constant and unremitting thought. It may be appropriate to say also that after fourteen years problems of munitions are as vital as they ever were and that one organization at least is pledged to industrial preparedness as a sure guarantee of peace.

A State Paper

WORLD PEACEWAYS, INC., an organization which like many others similarly engaged in the promotion of international peace is not over-careful of its estimate of the situation at home, was the unwitting cause of the issuance of a state paper recently. We call it a "state paper" because it bristles so whole-heartedly of sound American doctrine that it outranks in common sense many of the allegedly sane *commiqués* and *aid memoires* to which statesmen who pose under that title are a party. We call it a "state paper" too because it proves in our opinion the inherent correctness of the belief as generally expressed now as ever before that statesmen (?) make war and soldiers make the peace.

The exhibit which we offer in evidence is the following letter of Maj. Gen. Geo. Van Horn Moseley, Deputy Chief of the General Staff, who needs no introduction to readers of this Journal. An officer of distinguished record, with experience and ability of the highest order, General Moseley was informed recently by World Peaceways, Inc., of its plans to advertise peace. In addition to "arousing" the press of the country to "support and promote publicly the plans to advertise peace" the program concludes with "preliminary work in preparation for the introduction of an appropriation bill at Washington." To this letter General Moseley replied:

"I am deeply interested in your letter of the 14th instant, which has just come to my desk. Every sensible man must give his approval to any educational campaign that purposes to place before all peoples accurate analyses of those factors which tend to disrupt peaceful international relationships, as well as of those conducive to the preservation of peace. In fairness to our people, and especially to the men who compose the Army and Navy, you should be careful to extend your campaign for peace to include every country whose interests may now or in the future seriously conflict with those of the United States.

"Perhaps I am even more interested in the subject of peace than you are, for I am a member of the Regular Army of this nation. I have one son in that same Army. I have another son in the Organized Reserves. I have a third son growing up, possessed of a sound mind and a strong body. I shall attempt to see to it that he is prepared to assist in the defense of his nation, if the emergency should unfortunately arise, even while I try to instill in him a full appreciation of the wastefulness, tragedy and fearful costs of war.

"As president of the general council in the War Department, I am obliged to attempt the evaluation of the international situation, and I also must keep in accurate touch with conditions among our own people. Perhaps I may be pardoned if I tell you that any campaign directed solely to the undermining of our own strength disturbs me when I realize that there is unrest abroad and that our manpower at home is not as virile and as sound in mind and body as I would like to see it.

"Not long ago leaders who feel as you apparently do proposed that our nation declare an economic blockade against an important power in the Western Pacific. Here we had the peculiar situation of professed lovers of peace advocating a policy that would inevitably have led to a most difficult and dangerous international relationship. Had war resulted these same people would then have sat back while our depleted Navy was ordered out to make its effort.

"Unfortunately, civilization advances only by very short steps. Our voice is respected in international affairs only in

proportion to the size of our fleet, the number of our bayonets, and the extent of our bank account. It is unfortunate that this is still true in this funny old world.

"In my own personal opinion foreign powers, including our actual debtors overseas, would treat us with much more respect today if there was now floating with our fleet that 360,000 tons of naval tonnage which the Harding administration scrapped in 1922. No admiral in the world's history ever lost such a naval engagement.

"Your campaign is a commendable one, and I wish you success. I hope, however, that you will keep your feet on practical ground, and, therefore, I should like to see you solve some of the smaller problems first, and some of these problems are involved in the various echelons of our manpower at home. They involve obedience to law and order in our own local communities. I would feel more encouraged in our ability to solve the larger problems if I could see more progress in the solution of these local problems which are actually undermining American manhood.

"I earnestly believe that only through education can there be developed a lasting public opinion which will eventually preclude the possibility of war. Such an educational program must be world-wide in scope, for no matter how peaceful may be our own intentions, or how keen our own understanding, until all others have a like intention and understanding we must be ready to protect ourselves from the possibility of aggression. Events of the past year furnish ample and distressing proof of the readiness of nations to repudiate their treaties and agreements when they believe it in their own interests to do so. We can afford to relax our vigilance only as we are given conclusive evidence that international relationships are based upon honor rather than upon expediency. Until then we must be ready to oppose might with might—even while we continue efforts to convince the world that right alone offers any lasting solution to our common problems."

There is food for thought here. High-sounding altruism has cost us plenty in morale and money already. It is time that General Moseley's words be taken to heart. His state paper is a *credo* that has the unswerving assent of Americans who have peace and the national defense truly at heart.

General Moseley's reference to our ruthless scrapping of naval tonnage recalls the recent report of the Navy Department to the Senate Naval Affairs Committee. According to this report the Navy is now below treaty allowance by 135 ships of all classes and a total tonnage of 316,530. The ships required to complete the allowance are 3 aircraft carriers (55,200 tons), 9 cruisers (87,100 tons), 89 destroyers (133,500 tons), and 34 submarines (40,730 tons). As against this, other parties to the treaty have been progressing steadily toward the permitted quotas.

Our Dollar-a-Year Men

THERE is renewed reason for gratification these days in the contemplation of the type of men who are giving their services to the ordnance preparedness cause at the munificent recompense of a dollar a year. We refer to the splendid group of Ordnance District Chiefs, those civilian industrial executives, many of whom have served for years and others of whom are new additions to the roster. Pressing demands on some of the district chiefs have made necessary their relinquishment of their posts recently. In these cases the severance is formal and not strictly actual. The interest and constancy of the former chief is still, and we know will always be, as definite as when he was in office. The acceptance of Mr. Philip H. Gadsden and Mr. J. W. Rawle of the appointment to the Philadelphia District as Chief and Assistant Chief, respectively, and of Col. Winthrop Withington as Chief of the Cleveland District to succeed Mr. Henry C. Osborn, are significant additions to a group of patriotic public servants who add prestige to an already distinguished group. The country and the department are fortunate in having such men of proved industrial experience and personal integrity in their service.

All of them would object, we are confident, to any mention of the dollar-a-year aspect of their service. But it is a subject worth emphasizing when the cost of national defense is complained of by many who should know better. Here are men who give of their time and administrative talent to the promotion of industrial mobilization simply because they understand its importance to the country. They represent that great body of business and professional men whose work in the World War on the same basis is a tribute to the performance of those days. Without them, now and in future, the industrial side of the national defense cannot be. So we take this occasion to welcome the new officials and to congratulate again the old. And at the same time we point with pride to their service as a patriotic duty undertaken for the good of the cause—at a dollar-a-year and at no cost at all if the law would allow.

An Exhaustive Field Artillery Test

AN experimental Field Artillery battery of 75-mm. guns using standard commercial 1½-ton trucks is now undergoing exhaustive tests begun last spring which are aimed to try out under the most severe conditions the suitability of present designs for field use. The equipment was given preliminary tests at the Holabird Quartermaster Depot and at the Aberdeen Proving Ground and is now under the jurisdiction of the Field Artillery Board, Fort Bragg, N. C. The unit, at present, is at Fort Ethan Allen, Vt., where it is being subjected to all the rigors of the winter climate of the Green Mountain State.

The truck-drawn battery since June 1st last year has been subjected to a daily grind of the most exacting tests that could be devised for it in the deep sand, marshes and timberland of the Fort Bragg reservation. Every type of problem which in time of war would fall to the lot of such a unit has been assigned the battery under conditions most closely approaching those of actual warfare. Seldom have the vehicles traveled an improved road, most of their 3,000 miles having been acquired by cross-country routes where no roads have ever existed, through shell holes and bogs. In storm and at night, when due to the need of shielding the movement from the eyes of the "enemy's" airplanes, the battery moved in and out of position without lights of any kind.

To ascertain the practicability of such a unit in winter maneuvers under conditions prevailing in our northern border states, the battery left Fort Bragg early last month for a month's test in the vicinity of Fort Ethan Allen. The itinerary of march en route to Vermont included the eastern seaboard cities. Congressional and military observers as well

as the public were given an opportunity to view the unit in Washington on January 5th (photo page 226). Upon completion of the maneuvers at Fort Ethan Allen, the battery will return to Fort Bragg over the same route to comply with the remaining provisions of the test, following which it will be driven overland to Fort Sill, Okla., where it will be delivered to the 1st Field Artillery. There it will be submitted to tests under conditions of that area with a possible trip to the Mexican Border.

The outstanding characteristic of the test battery is that all its sixteen automotive vehicles are standard commercial trucks and station wagons. The wisdom of the policy of using commercial equipment wherever possible for military use was established long since. The proving of the equipment itself as indicated by tests of the nature described above, will not modify the principle. With our unsurpassed commercial automotive facilities and the alertness of our automotive designers and engineers, the national defense rests upon a firm foundation when its needs are drawn from everyday commercial sources which make unnecessary special military designs. There was a day when the popular viewpoint was expressed in special equipment for nearly every undertaking. Happily this theory did not become accepted practice. With the standardization of commercial tractors was begun the policy which is now universally in effect. From the supply as well as the performance considerations the policy is a wise one. We are quite content to believe that in nine cases out of ten standard commercial "jobs" will fill the Army's needs. Only in those categories where there is no commercial production need the military establishment spend its effort and money on special designs.

More on the Pamphlet Racket

ON several occasions we have taken the liberty in these columns of decrying the value of much of our Federal literature. The sore spot was especially painful in the recollection that millions of dollars of Federal funds were being expended annually for brochures on folderols while the technical reports of the Ordnance Department, for example, are not deemed worthy of the public press.

Now comes the "Catalogue of the Public Documents of the Seventieth Congress and of all Departments of the Government of the United States for the Period from July 1, 1927, to June 30, 1929"—weight 7¼ pounds, dimensions 7¾x11¾ inches, 2512 double column pages. This, according to the Superintendent of Documents, is the largest document catalogue, but one, yet published.

Some of the titles in the catalogue are extremely important. They include "Present Trends in Home Sewing"; "Breaking and Training Colts"; "Sixty Selected Stories for Boys and Girls"; "The Proper Food of Bullheads" (See Catfish); "Eggs at Any Meal"; "Dresses for the Little Girl" and "How Shall we Teach the Eighteenth Amendment?" It is only fair to say that many of the titles—particularly the last—are in decreasing demand and that the falling market for Federal literature augurs well for the ultimate extinction of a lot of it. The absurdity of it all, however, is emphasized by the lack of good sense in the choice between the things that should be done and those that should not. And therein lies the difficulty. If one goes back to fundamentals he finds that "to promote the common welfare" is set out in the Constitution as a function of Government equally with "to provide for the common defense." Warped interpretations of these mandates have brought about an insane understanding of the general welfare clause and an inane misunderstanding of the common defense. Thus the latter is pushed from pillar to post, inroads are made on its stability if outright antagonism is not shown to its very existence. The ramified, implied powers of the general welfare clause has become the great high mogul to whom are offered, among other things, the contents of the Catalogue of Public Documents. A more hardy statehood and citizenship would leave to the initiative of individuals the preparation of treatises on "Methods and Equipment for Home Laundering" and the sale thereof to home launderers who might care to buy them. To do otherwise is paternalistic. By the same reasoning, dainty morsels for the catfish would be determined by anglers and, if there is a market, some disciple of Walton would supply the treatise to fellow disciples who are interested enough to defray the cost.

For all that, we cannot help observing that another generation of Americans—they who looked to their Kentucky rifle as a friend—would undoubtedly have made sport of "Eggs at Any Meal," "How Shall We Enforce the Eighteenth Amendment?" etc., etc. Which may go to prove that one's trusty musket and how to use it when needed are still far more important to virile citizenship than food for the catfish can ever be. Now that the more pressing needs of the people are uppermost in all minds possibly this doomesday book of useless Federal literature will next appear in a considerably abridged form with all the buncombe expurgated and a few necessary titles—for instance, "Gas Masks, their Use and Abuse" and "Home Care of the Semiautomatic" added.

Doctor Gerlich's Achievement

ARMY ORDNANCE has the unique distinction of publishing in this issue some of the latest results of Doctor Gerlich's remarkable achievement in developing his high-powered shoulder rifle. The pleasure is hastened by reason of the fact that several years ago when a rather skeptical audience in various countries looked askance at his claims, this Journal was among the few to help bring the possibilities of the Ultra rifle and its ammunition to general recognition. The pictorial evidence on pages 218 and 219 is to our unofficial viewpoint distinctive as much in its implications as in its actual results. At least we have evidence of the beginning of what may be a revolutionizing change in the conduct of warfare.

Further development will be awaited with much interest and in the meantime followers of the doctrine that no new force is long without a counter-irritant will look with anticipation to those results. The effects of higher velocities and their penetration of armor may well change our present understanding of battle. If the tank is all that its enthusiastic proponents claim for it, at least there is now on the horizon a new form of opposition. With weight an always governing factor and therefore a limitation on armor-plate protection, the tank designer and the tank user will realize that higher velocities in the hands of the infantryman may lessen the bark as well as the bite of their favorite weapon.

Whatever the implications of higher velocities it is at least correct to say that no new reasonable idea should ever be

tossed aside without investigation. As a principle this applies equally to civilian and military pursuits. Thus it might be set down as a maxim that national defense progresses best when it is fostered by an open mind sure of its fundamental principles and alert to all new changes.

The Army and Citizenship

SEVERAL extremely appropriate suggestions have been made recently looking toward an expansion of the activities of the Army in citizenship. One cannot logically discuss the subject without raising a loud complaint against the Taber amendment inserted in the current Army bill by the House of Representatives. It is a pay reduction measure as unfair, discriminatory and unsportsmanlike as any class legislation could ever hope to be. Its effect on officers in the regular service with prior enlistment or National Guard service amounts in some cases to more than 30 per cent. Its effect on Military Academy graduates is this: a colonel graduated prior to 1902, no reduction; a lieutenant colonel prior to 1905, $211.08 or 3.1 per cent; majors prior to 1909, $320.88 or 5 per cent; prior to 1912, $1132.56 or 17.8 per cent, prior to 1916, $137.52 or 2.6 per cent. The per cent of pay losses varies widely with different classes. There have been inequalities in the pay status and they should be remedied but not by further inequality. The Senate undoubtedly will see to it that there is no monstrosity like this foisted on one group of public servants who are doing in addition to hundreds of other duties a sterling work for citizenship. We refer to the Citizens Military Training Camps.

On this subject the *New York Times* said editorially, "Never was there a time when they were so useful and timely, so much needed as training grounds not only for young men who might have to answer a call to the colors but as builders of character and manhood and good citizenship. Happily, the depression has not impaired this institution of optimism and patriotism. If all that these camps accomplished were the use of arms and evolutions on the drill ground, they might be spared in times of peace. The practical wisdom of General Laubach, far removed from mere idealism, was enlightening in an address he made last summer at Camp Dix, where he commanded: 'The central aim of the Citizens' Military Training Camps is to turn out as a finished product young Americans on whom the country can rely in the ever-present trials of peace as well as in the remote possibilities of war.' Every member of Congress should at some time or other visit a citizens' training camp and see for himself that it is too precious a part of American life to be misunderstood or neglected."

Similarly there is merit in Senator Couzens' proposal that the Army take over the care and training of several hundred thousand homeless boys now roaming the country until they can be absorbed in commercial and business life. This has some common points with similar undertakings in Germany and Bulgaria. According to the *Manchester Union,* "In those countries voluntary labor armies are maintained by the government for young men unable to find employment in civil life. They live in army quarters under military discipline. They are uniformed and fed by the government, but receive no pay, though they are used on various federal emergency works appropriate to the capabilities of the volunteers. Bulgaria, which undertook the scheme as a depression relief measure, has reported that the volunteer workers are extremely proud of their organization and that the morale is high. Germany has found the plan a surprisingly successful antidote for political unrest, besides easing the labor market.

"Our summer training camps have paved the way for such a development in this country. The beneficial consequences to the nation at large, besides the moral and spiritual, would include such practical advantages as an increased demand for food to feed them, for uniform cloth to clothe them, for such tools as they required in the work assigned them, and for transportation. If Senator Couzens' plan proved successful and money was available, it might easily be expanded to include other classes of the unemployed without unfavorable disturbance of the American labor market.

"Some of the federal funds now spent for relief purposes could probably be diverted to such a purpose with more advantageous results than these expenditures are accomplishing at present."

In any event the American Army within itself is doing splendid work for citizenship and its officers should not be penalized. On the contrary a higher appraisal and better treatment should be accorded their labors in all fields and especially in that of the citizen soldier. There are few enough places where real American citizenship is fostered. It remains for the Army to do it and do it well.

It is because of this responsibility and this dual relation of citizenship: the Army officer as a citizen entitled to fair treatment and as an official inculcating American ideals especially among his younger fellow citizens, that the very fiber of the national defense is weakened when unfair methods are employed. This applies both to the active and the retired officer. Every one who is not hostile to the national defense—and to American citizenship—will subscribe heartily to General MacArthur's statement on January 31:

"Our retirement laws, probably more than any other single factor, are responsible for the high morale traditional in the Army and for the attraction of splendid types into the military service. I therefore regard it as particularly dangerous to enact legislation seriously and arbitrarily restricting the operation of this system, which has been in effect for nearly three quarters of a century. American soldiers have withstood many privations: have often been poorly paid, particularly in times of relative prosperity, and have served uncomplainingly under conditions of hardship and exposure. Through it all there never has been a question of their devotion to duty or of their efficiency in the government's service. A high sense of duty has carried them safely through every difficulty and discouragement, but any act of Congress which would be interpreted as a definite intention of emasculating the time-honored right of retirement would be an overwhelming blow to their enthusiasm and morale.

"I urge that the two amendments affecting retirement and credit for length of service be stricken from this bill. To do so will not add one cent to the total sums now appropriated therein. It is my earnest conviction that nothing else you can do will go so far toward preserving the efficiency and morale of the Army and of according justice to its officers. Their complete confidence in the definite commitments and promises of their government is the cornerstone on which rest their hopes for material happiness. Destruction of that confidence would be a tragedy to them and a serious threat to the efficiency and effectiveness of the Army of the United States. It would break the backbone of National Defense."

International Debts and Territory

An Editorial

THERE are many indications in recent articles of our writers on international subjects that a method is being sought by which we may untangle the snarled international conditions which are preventing at this time the forward progress of the world. Army Ordnance has devoted its pages consistently to the material side of our preparedness program but its cardinal thought in this policy has been the maintenance of world peace. Many inquiries have appeared in letters in the daily press, in magazines and in our own correspondence as to the relation of territory and international debts. A review of this subject and the expression of our opinion upon it in the interests of international safety would seem to be timely and appropriate. If further justification be necessary for what may seem on our part an expedition into the sacrosanct but muddling field of the diplomat, may we observe that every mention of our international credits raises a lot of silly talk among so-called statesmen about the relation between armament costs and international debts. Since armament is dragged into the fray, willy nilly, then we had best be frank even if apparently afield. At least opponents of armament insist on the connection between guns and debts, and where armament is debated we sense a right of expression.

WHEN the United States made the momentous decision to prevent the indicated expansion of Germany in Europe and in the distant parts of the world by armed intervention, in some measure at least, it established a policy of Anglo-Saxon solidarity in the conduct of future political planning of life on our planet. It was not the call of Belgium or of France that influenced the majority of our people. It was indeed a response far more to the pleading of a paternal ancestor, seeking the aid of his children and children's children in the defense of the family traditions and the ancient home places.

As soon as the war ended in a family victory, we as a nation resumed very promptly the old separatist attitude, lest we be drawn again into the conditions from which our forefathers rebelled not so many generations ago. President Wilson, it is said, made this plain in a speech at Buckingham Palace after the World War when the intimate relationship of our two countries had been slightly overemphasized during his visit. "We are not your brothers and sisters," he said in substance, "we are not even your cousins in the sense of national relationship, but are a separate political entity without Old World connections or ambitions in any form. In all matters of world planning, we intend to pursue an independent policy, uninfluenced by any national origins of our people, in so far as we are able to guide our destiny." An Englishman who was present and who spoke of this speech expressed a lively sense of horror that an otherwise harmonious party should have been spoiled by such a sour note.

In spite of our consistent independence, and our evident fear of British influence or of British power in our international relations, we retain a subconscious sense of unity through our hereditary institutions, our language, our standards of time, distance and mass and our social customs. There is no doubt that this underlying sense of relationship is fostered as much as propriety will allow by the British official society and by many of our own citizens with English connections or with high admiration of British standards and methods. A large majority of our people, in spite of the loud arguments of a former mayor of Chicago, consider a future war with Great Britain impossible and unthinkable. It is a self-evident truth that we are closer in nearly every way to England than to any other people or government in the world. It is also true that our government imposed upon any people now under British control, would cause less resentment than the substitution of any other government.

WITH this thought in mind, let us consider the territory now under control of Great Britain in the Western Hemisphere to see whether any world improvement would result from a transfer of sovereignty.

Canada, our northern neighbor, is a definite political entity in all world councils. It is only a part of the British Empire by its individual choice as a dominion, in so far as we are able to understand the British Commonwealth. It therefore deserves and has a complete right to demand a full voice in any consideration of its domain. Its territory cannot be considered in the light of mortgaged property which under civil law might be seized in foreclosure proceedings looking to debt settlements. It was not a party to the British debt as a co-guarantor of payment. Our relations with reference to the purchase or exchange of territory on the north of us are principally with the Dominion of Canada.

The treaties which have been negotiated regarding the St. Lawrence ship canal have brought forth the question of propriety of our government investment in a foreign country on such an immense scale. The suggestion has been seriously made that our northern boundary be extended to the St. Lawrence River and the Welland Canal to avoid future complications and to offer us a fair opportunity to participate in the power and transportation advantages in the Eastern United States.

The dividing line between the two countries, established by an international canal, operated by a Canal Authority owning all canal and power developments, and charging the users proper liquidating rates for them, seems to be a reasonable arrangement. The adequate protection of this great waterway to be offered to world shipping ought to be guaranteed throughout its length by the two governments and each guarantor should have access to the waterway at any point for such protection.

If there be any advantage in this acquisition of territory, Canada must necessarily be compensated for its loss in full measure. The nearest territorial exchange which might be considered in this connection would be the transfer of the Territory of Alaska to Canadian sovereignty. The value of each area would have to be agreed upon in joint conference and a complete settlement made as to the established values. The adjacent states then might be allowed to profit by the extension of their northern boundaries through congressional action over any new territory which might be obtained if ever an agreement should be reached to make an exchange of areas. This certainly is a problem by itself and has no relation to the debts of Great Britain to the United States.

Whether the territories whose sovereignty was changed would gain by this transaction, or whether world conditions would be improved thereby would require the serious consideration of the problem by Canada, ourselves and Great Britain, as well as by the states, territories and provinces affected.

UNDER the sovereignty of Great Britain in our hemisphere, there still remains much island and continental area which may be considered in the light of land and property subject to mortgage foreclosure proceedings under civil law for the collection of debt. Of course, we should not consider such proceedings in international councils and they are mentioned here solely for the purpose of illustration. These territories include the Bahama Islands, the Bermuda Islands, the Leeward, Windward, Turk and Cayman Islands, Trinidad, Tobago, Jamaica, British Honduras, British Guiana and other smaller areas. Altogether these possessions represent an area of about 110,000 square miles and a population of slightly over two million people. In addition there are a number of small islands and groups in Polynesia that lie within the sphere of influence of the United States and whose people are similar in language and customs to our Hawaiian population.

The possession of all these areas by any world power other than ourselves constitutes a military neighborhood risk that might concern us seriously some future day. Our possession of these areas would offer to us a sense of security and an American responsibility consistent with our Monroe Doctrine. It would settle for our merchant marine and our expanding air transport industry many difficult questions. It would reduce greatly the cost of protection of the Panama Canal. It would add many advantages and develop few new problems for which we have not already found solutions.

From the standpoint of the residents of these areas, there would arise among the Anglo-Saxon population considerable opposition to any changes enforced by the present sovereignty. But the form of government, the customs, the general mode of life, the law system and other intimate conditions of living need undergo very little and very gradual change under American rule. Citizenship would remain naturally in accord with our established policies, the individual choice of each inhabitant. Within a generation, all antagonism could be amicably eradicated by proper handling of each situation. In the long run, each area ought to receive considerable commercial advantage from the change of sovereignty.

From the standpoint of Great Britain or of the British Commonwealth, the loss of this territory is more than balanced by the additions to the British Empire received from the World War, for whose conduct the present war debts were contracted. The sovereignty over these areas would pass to a friendly nation against whom there is little or no likelihood of any war. There is no likelihood of any lessening of the high seas protection to British commerce in the areas. A fleet of equal strength and the army of a strong nation would serve to maintain the security of the local governments. The income to the British treasury ought to be more than compensated by the cancellation of a large portion of the debts or perhaps by some immediate payments from the United States. From the vast area of the British Empire, over fourteen million square miles and from the enormous population of over 500 million people this deduction would be hardly noticeable. Diplomatic negotiations ought to be able to fix upon a fair arrangement for the whole transaction.

From the standpoint of world conditions, there ought to be a general improvement. The transfer from one Anglo-Saxon power to another should not disturb the general balance of power, particularly in view of the traditional amity of these two nations in times of world conflicts. The important questions of coaling stations and other details should be capable of adjustment in such a transaction.

AN expansion of the United States such as this would naturally arouse some fears on the part of South and Central American countries, but the expansion would not be of much importance in Spanish-speaking areas. There could be no loss of position in trade with South or Central America due to such a change. The trade conditions need not be interfered with. They ought to be markedly improved. The position of the United States within the Americas would not be greatly augmented from a military viewpoint over its present situation in Caribbean and South American waters with reference to the local defense of the American nations, yet it would be markedly improved in support of its traditional doctrines with reference to European encroachment upon the Americas.

It would be a reasonable position for the United States to guarantee to all South and Central American States, that no more armament should be placed in the continental areas than is required for local preservation of order. It might even go so far as to offer a plebiscite to these areas with reference to their independence or their union with adjacent American States to reassure the South and Central American States.

Indeed from a world point of view, it is always a sensible arrangement to make to remove local opportunities for difficulty, to establish defendable boundaries of empire, to eradicate division of sovereignty in adjacent areas, and in every practicable way to adjust the control of the areas of the earth for their safety and their best opportunities of advancement. The British Empire ought to improve its world position by showing an attitude of recession where manifest betterment of world conditions can be established thereby. Such a movement would be far more valuable than any amount of disarmament which may be agreed upon at Geneva. If Britain has any faith in its professed friendship for the American nation, it cannot lose by such a transfer of sovereignty. And if America, despite the recent transfer of gold, is not now convinced of British friendliness, such an arrangement would be a most persuasive argument toward establishing a permanent condition of friendly coöperation toward better world conditions.

There has been mentioned with much emphasis this last year the question of a new deal. It is to be hoped that this refers to our international game of diplomacy as well as to our playing in the national game of politics. In both games, we are tired of looking at the old cards through these years of depression. We cannot see how to play them. Indeed some of them are unplayable, and the game drags. Is there any truly valid reason for hesitation over this opportunity for a truly promising new deal of debts and territory?

A settlement of international credits through exchange of sovereignty ought to help toward restoring an economic balance, toward restoring the balances of gold, toward making international obligations more highly respected in all world areas. It might open a way to a new common sense era. Certainly there rests in this question an opportunity to establish safer world conditions all over our trembling planet.

Association Affairs

Our Fourteenth Annual Meeting

THE Fourteenth Annual Meeting of the Army Ordnance Association held under the auspices of the New York Post at the Union League Club in New York City, Wednesday, December 21, 1932, was one of the most successful and significant in the history of the organization. More than 200 members and guests were assembled for dinner in the hall of the Club which preceded the meeting. The dinner was in compliment to Hon. Newton D. Baker, Secretary of War 1916-1921, and Mr. Alex Dow, Chief of the Detroit Ordnance District, who were the principal speakers, and to the Association Medalists for 1932: Col. Frank A. Scott, Brig. Gen. John H. Rice and Brig. Gen. C. L'H. Ruggles. Brig. Gen. Benedict Crowell, President of the Association, presided. He was presented to the meeting by Brig. Gen. Samuel McRoberts, Chief of the New York Ordnance District, a director of the Association and president of the New York Post.

The New York Ordnance District, in whose area the meeting was held, participated in the function with its assigned officers, advisory board and manufacturers concerned with industrial preparedness. Also participating were the ordnance officers assigned to the Second Corps Area whose principal mission is the supply and maintenance of ordnance in the field. The New York Post of the Association, dedicated to the advancement of ordnance knowledge and the support of ordnance organizations in the New York area, was in charge of the arrangements which were splendidly handled under the direction of Col. James E. McNary, ably assisted by Lieut. Col. Chas. G. Mettler, Lieuts. C. Wingate Reed and W. S. Broberg. (The addresses delivered by Secretary Baker and Mr. Dow appear on pages 195 and 227, respectively, of this issue.) General McRoberts' address was as follows:

IT is my great pleasure to represent before you for this moment our three Ordnance organizations in and around New York City, as well as the Metropolitan Section, American Society of Mechanical Engineers, and to express for them the gratification we feel over the selection of our principal city as the meeting place of the Army Ordnance Association. This is indeed the birthplace of the Association. The principles and traditions it has developed in the last twelve years are cherished here as strongly as any other place in our country. One of its first children, the New York Post, of which I now have the honor to be President, is a virile and aggressive organization in the cause of Ordnance Preparedness. It is striving to gather around it all those reserve Ordnance Officers, business men, manufacturers and believers in industrial war strength, who can be attracted to its standards. At its meetings, it has succeeded in keeping before its community, the importance of developing the national strength through organized effort, especially that great portion of the war potential that exists in our varied industries and industrial organizations. The New York Post is the common meeting ground of the district officers, the Corps Area Ordnance Officers, the Corps, Washington and arsenal assignment officers, the regular Ordnance Officers both active and retired, the engineering society members interested in national defense and those civilian members of the Association engaged in local business and industry. Its meetings have been well attended and enthusiastic. The last two meetings have assembled 200 guests.

"The District and Corps Area officers of the Post have withdrawn temporarily from their parts of duty this evening and have placed this organization in command of a distinguished Vice-President, one of the best supporters of ordnance activity in our area, Col. James E. McNary.

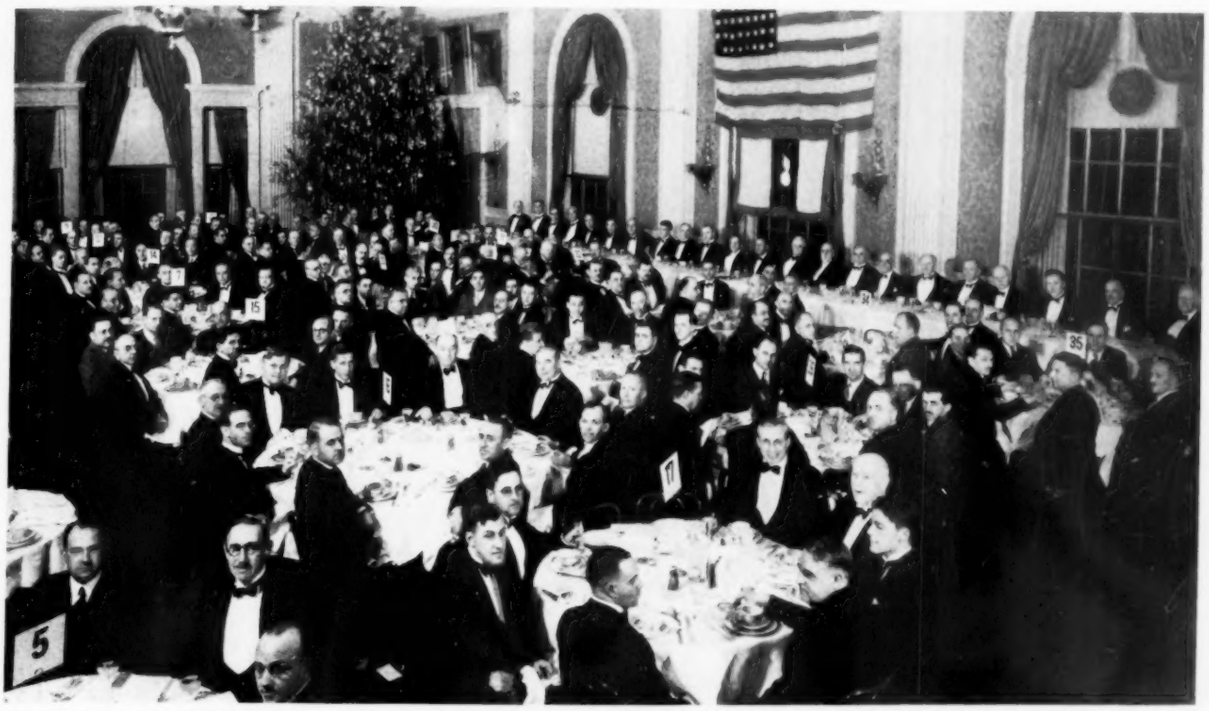
"I have been assigned for my reserve duty as an ordnance officer to the task of Chief of the New York Ordnance District. The District during the past year has developed a new organization for its war headquarters and has set for itself a definite program of training in order that it will experience the least possible delay in assuming its duties in time of emergency. The training is carried on at weekly meetings where the attendance has been large and businesslike. Over seventy members per week have taken part in this definite preparation for active effort in war. Col. F. W. Roller, the Assistant District Chief, is in charge of training.

"The actual survey of District plants and industrial organizations has been made an important part of our program for the year. The schedules received from Washington have been restudied. The ammunition manufacturers were assembled at luncheon, their particular tasks and orders for emergencies were shown on charts and the reasons for their selection explained in full. The optical manufacturers have been visited and their work coördinated. More than ninety per cent of the assigned District work has been definitely indicated and the additional requirements for forgings, machinery and loading have been planned in a large measure. The District is confident that it will be able to place in the hands of capable industrial organizations at the very outset of war all that is now required of it and in addition will absorb many new requirements for matériel not yet standardized or allocated. Colonel Mettler, our District Executive, is in charge of this phase of our work. I need not add that his activities are not limited to this work alone.

"The District not only feels the local support of members of the Army Ordnance Association but also has been given the advisory support of many prominent men within our area, representing many fields of national commerce. They constitute the Advisory Board of the New York Ordnance District. It would give the Association and the District much pleasure to express our thanks for their support. I will ask each one of those present to rise as his name is called. Those present are: Mr. J. M. Davis, President, Lackawanna Railroad; Mr. W. C. Dickerman, President, American Locomotive Company; Mr. J. I. Downey, Vice-President, Bankers Trust Company; Gen. J. G. Harbord, President, Radio Corporation of America; Mr. H. P. Howell, President, Commercial National Bank and Trust Company of New York; Mr. J. A. Farrell, Former President, U. S. Steel Corporation; Hon. Nathan L. Miller, Former Governor of New York; Mr. Malcolm Muir, President, McGraw-Hill Company; Col. Douglas I. McKay, President, Standard Coupler Company; Mr. H. Hobart Porter, President, American Water Works and Electric Company; Col. James L. Walsh, Executive Vice-President, Guardian Detroit Union Group; Mr. B. L. Winchell, President, Remington Rand, Inc.; Mr. W. H. Woodin, President, American Car and Foundry Company. Other members of the Advisory Board, not able to be with us tonight, are Mr. Seward Prosser, Chairman, Managing Committee, Bankers Trust Company; Mr. P. E. Crowley, Chairman, New York Central Company; Mr. F. C. Wright, Lee, Higginson & Company, and Mr. Owen D. Young, President, General Electric Company.

"We have with us also a splendid showing of our industrial strength as you may see by looking around you. I desire to express the appreciation of the District for their splendid cooperation.

"The Second Corps Area is represented here by its distinguished commander, Maj. Gen. Dennis E. Nolan. On his staff are Colonel Ramsey, Captain Elliott and Lieutenant Reed. The Ordnance Reserve Officers under his command who will assist in the supply and maintenance of ordnance in time of war are well represented in this audience and join with me in this welcome to our National Association. We do not forget in our



Fourteenth Annual Meeting of the Army Ordnance Association Held at the Union League Club, New York City, December 21, 1932

Seated at the Speakers' Table (Left to right): Col. James E. McNary, Ord. Res., Chairman, Dinner Committee; Brig. Gen. John Ross Delafield, Ord. Res., Counsel of the Association; Frank B. Bell, Chief, Pittsburgh Ordnance District; John C. Jones, Director of the Association and former Chief, Philadelphia Ordnance District; Ralph M. Dravo, Director of the Association and former Chief, Pittsburgh Ordnance District; Brig. Gen. John H. Rice, U. S. Army, Ret., Association Medalist, 1932; Col. Charles L. Harrison, Ord Res., Chief, Cincinnati Ordnance District and Chairman of the Committee on Awards; Col. Frank A. Scott, Ord Res., Association Medalist, 1932; Maj. Gen. Dennis E. Nolan, U. S. Army, Commanding General Second Corps Area; Hon. Frederick H. Payne, The Assistant Secretary of War; Hon. Newton D. Baker, former Secretary of War; Brig. Gen. Benedict Crowell, Ord. Res., President of the Association; Brig. Gen. Samuel McRoberts, Ord. Res., President, New York Post; Alex Dow, Chief, Detroit Ordnance District; Maj. Gen. Samuel Hof, U. S. Army, Chief of Ordnance; Philip H. Gadsden, Chief, Philadelphia Ordnance District; Col. Robert P. Lamont, Ord. Res., Director of the Association; Col. William C. Spruance, Vice-President of the Association; Brig. Gen. Palmer E. Pierce, formerly member of the War Industries Board; Col. James L. Walsh, Ord. Res., Director of the Association; Brig. Gen. Chas. Elliot Warren, Treasurer of the Association, and Col. Chandler Smith, Military Order of the World War.

city to give full credit to the Field Service part of our Ordnance work. The senior Reserve Officer in command of this group tonight, another able supporter of our local work, is Col. H. B. Machen.

"The American Society of Mechanical Engineers through its National Defense Committee of its Metropolitan Section, is also represented in this audience. It has ably assisted us in many important ways. It has expressed to me its pleasure in this exhibition of local interest on the part of the Army Ordnance Association. Col. Calvin Rice, Secretary of the American Society of Mechanical Engineers, is the District Commander of the Engineering Group this evening.

"These organizations, Mr. Chairman, which I have mentioned have expressed their particular satisfaction that they have been granted the opportunity to join with you in complimenting the former Secretary of War, the Honorable Newton D. Baker, whose distinguished service to the nation has been a source of inspiration to all of us. They are pleased also to join with you in complimenting those medalists who are to be honored by the public recognition of your Association.

"It is our hope that the Association will honor us again as it has tonight with an Annual Meeting."

IN presenting the Association's Medalists for 1932, Col. Charles L. Harrison, Chief of the Cincinnati Ordnance District and Chairman of the Association's Committee on Awards, addressed the meeting as follows:

"Mr. President, on behalf of the Committee on Awards of the Army Ordnance Association, which by your appointment consisted of Mr. Pliny E. Holt of San Francisco and Col. James L. Walsh of Detroit as members and myself as Chairman, I am pleased to report that after deliberation and with the subsequent approval of the Committee's recommendations by the Board of Directors of the Association, the Gold Medal of the Army Ordnance Association for meritorious service for the year 1932 is awarded to the following:

"For leadership and administrative ability in the progress of munitions preparedness to Col. Frank A. Scott of Cleveland, Ohio, founder and chairman of the General Munitions Board and later first chairman of the War Industries Board, 1917, Chief of the Cleveland Ordnance District 1924-1923, advisor to the Army Industrial College since 1925 and a director of the Army Ordnance Association since 1919. Long identified as a student of military affairs, a leader in civic enterprises and an industrialist of abilty, Colonel Scott rendered outstanding service to the nation in organizing its industrial power in the early days of the World War. Oblivious of self he undertook a gigantic task and gave intensely of his talent and application. He has continued in the intervening years to merit the esteem and admiration of all friends of industrial preparedness. In acknowledgment and tribute to his leadership and ability the Association makes its award to him.

"For meritorious service in the invention, design, development and manufacture of military armament to Brig. Gen. John H. Rice, U. S. Army, retired, of New York. A graduate of the United States Military Academy, class of 1893, General Rice served in various posts of responsibility reaching the grade of Colonel in 1917, when he was Chief of the old Carriage Division, Office of the Chief of Ordnance. In this capacity he reorganized and expanded the Division and was responsible for placing orders and contracts for more than $700,000,000 worth of materials and facilities for the design, procurement, inspection, test, issue, repair and maintenance of all special motor equipment and all classes of gun carriages for field, railway and coast artillery and their accessories. He served as Chief Ordnance Officer of the Amer-

ican Expeditionary Forces in France in 1918 and later was Chief of the Manufacturing Service of the Ordnance Department until his retirement in 1921. The Army Ordnance Association is proud to join in this public acknowledgment of his service and add its award to that of the United States Government and the Government of France which have similarly honored him.

"For unusual accomplishment and outstanding service in the advancement of industrial preparedness to Brig. Gen. C. L'H. Ruggles, U. S. Army, retired, of Charleston, S. C. A graduate of the United States Military Academy, class of 1890, General Ruggles served through grades and was promoted to the rank of Colonel in 1917. After a tour of duty as Professor of Ordnance and Science of Gunnery at the Military Academy, General Ruggles was in command of several ordnance establishments including the old Sandy Hook Proving Ground and the Aberdeen Proving Ground which he established. During the World War he served as head of the Inspection Division of the Ordnance Department and later with the A. E. F. As Chief of Manufacture General Ruggles rendered exceptional service in promoting our industrial mobilization plans. To him as much as to any other one man is due the success and coöperation on the part of industry which have attended this important phase of the national defense in recent years. General Ruggles retired from active military service in 1930. Unfortunately his health would not permit him to make the journey from South Carolina to New York for this function, and while I take pride in announcing the award I regret that he is not able to be here to receive it. On behalf of the Committee, and I am sure of his associates of our organization, we convey to him our best wishes for an early recovery. General Ruggles has requested that his former assistant, Colonel Mettler, accept the medal for him. I will now ask Colonel Mettler to do so."

Annual Meeting of Trustees and Directors

COINCIDENT with the Fourteenth Annual Meeting of the Army Ordnance Association the annual meeting of trustees and directors was held at the Union League Club, New York City, on the afternoon of December 21, 1932. General Crowell, president of the Association, presided, and the following officers, trustees and directors were present: Col. William C. Spruance, vice-president; Brig. Gen. Chas. Elliot Warren, treasurer; Brig. Gen. John Ross Delafield, counsel; Brig. Gen. Samuel McRoberts, Col. Robert P. Lamont, Col. Chas. L. Harrison, Col. Frank A. Scott, Col. James L. Walsh, Mr. John C. Jones and Mr. Ralph M. Dravo, directors, and Maj. L. A. Codd, executive secretary. Also present by invitation of the board were Maj. Gen. Samuel Hof, Chief of Ordnance, and Lieut. Col. Charles G. Mettler, Secretary, New York Post, Army Ordnance Association.

Following the reports of committees and of the treasurer and executive secretary, discussion was devoted to an analysis of the affairs of the organization and plans for sustaining its activities on their present scale.

General Warren, treasurer, in his report disclosed that the Association was exceptionally fortunate in concluding the year's activities without a financial deficit. Despite unusual reductions of income, operating expenditures were kept within the limit of receipts.

After lengthy consideration the board adopted a recommendation that the annual membership dues, effective January 1, 1933, be reduced 20 per cent, from $5.00 to $4.00. This action was taken in an effort to show, on the part of the Association, its appreciation of the continued coöperation of all old members. In conformity with this action, the board amended those sections of the By-Laws which relate to membership dues. The board also decided to urge as many individual members as possible to transfer their membership status to that of life members. The funds accumulated from this source are placed in the Association's reserve and they serve as a sustaining nucleus for operations not only during the present emergency but for the years to come. Through this means it is hoped that the unusual losses in members due to present conditions can be obviated to a very large extent.

Plans for the year 1933 as proposed in the budget of expenditures submitted by the executive secretary anticipate further reductions in operating expenses without curtailing the organization's activities.

The balance sheet as of December 31, 1932, as compiled by Messrs. Ernst and Ernst, certified public accountants, who conducted an audit of the accounts of the Association as of that date, showed a surplus on the year's operations of $98.03, and an increase in the operating reserve of $986.97, notwithstanding the fact that there was a depreciation in security values of $623.75. The balance sheet follows:

BALANCE SHEET
ARMY ORDNANCE ASSOCIATION
December 31st

Assets

	1932	1931
Cash on hand	$ 15.00	$ 15.00
Cash on deposit	4,948.24	4,850.21
Accounts receivable:		
Due from advertising	714.47	275.00
Other Assets:		
Securities owned	23,602.50	24,231.25
Postage	109.43	227.67
Permanent:		
Furniture, fixtures and supplies	1.00	1.00
	$ 29,390.64	$ 29,600.13

Liabilities

Unearned income:		
Prepaid membership dues	$ 6,581.70	$ 7,895.41
Prepaid subscriptions to magazine	1,095.00	1,077.75
Reserve:		
Endowment	822.50	822.50
Life memberships	1,100.00	1,000.00
Operating reserve	19,791.44	18,804.47
	$ 29,390.64	$ 29,600.13

Note: Securities are carried at market value.

The board was unanimous in the opinion that the reduction in annual membership dues would meet with the approval of all old members and that the unusual attrition in membership of 306 for the year 1932 will be materially lessened if not actually converted to an increase in membership during the coming year.

Colonel Withington Succeeds Mr. Osborn as Cleveland Ordnance Chief

AT a dinner at the Union Club in Cleveland, December 21, 1932, the resignation of Mr. Henry Chisholm Osborn as Chief of the Cleveland Ordnance District was announced. The heavy burden of his interests as vice-president and chairman of the executive committee of the Addressograph Multigraph Corporation had compelled him to relinquish his duties after a four-year tenure. Mr. Osborn will continue, however, as a member of the Advisory Board of the district.

In accepting Mr. Osborn's resignation, Brig. Gen. William H. Tschappat, Assistant Chief of Ordnance, who was in Cleveland for the occasion, announced the appointment of Lt. Col. Winthrop Withington, Ord. Res., as the new district chief. Colonel Withington is well known in Cleveland as the vice-president and manufacturing director of the American Fork & Hoe Company. He was educated at Andover, the Chateau De Lancey, Switzerland, and at the University of Michigan.

During the World War, Colonel Withington joined the Ordnance Department as a captain, served in the United States and in France in both Ordnance and General Staff capacities and returned with the rank of lieutenant colonel. Combining the qualifications of an industrialist with an unusual personal experience in military affairs, Colonel Withington's appointment will meet the hearty approval of his many friends and associates in civilian and military circles.

In addition to the guests of honor at the dinner, Mr. Osborn

and General Tschappat, the following men, prominent in industrial and military matters in northern Ohio, were present: Mr. George C. Brainard, President, General Fireproofing Company; Mr. W. H. Foster, Chairman of the Board, General Fireproofing Company; Col. J. B. Dillard, General Superintendent, Cleveland Twist Drill Company; Mr. W. King White, President, Cleveland Tractor Company; Lt. Col. Harry Hawley, Inf., U. S. Army, Executive Officer, Ohio Military Area; Lt. Cols. Arthur B. Roberts, Robert R. Abbott, Furman G. Spencer, Ord. Res., and Maj. R. W. Pinger, Ord. Dept., Executive Officer of the Cleveland Ordnance District.

St. Louis Post

LIEUT. COL. TOWNSEND WHELEN, Ordnance Officer, 7th Corps Area, was the principal speaker at a joint meeting of the St. Louis Post, Army Ordnance Association, and the local chapter of the Reserve Officers' Association in St. Louis November 28, 1932. Col. Harry Scullin, President of the St. Louis Post, presided at the gathering which was held in the auditorium of the St. Louis University Medical School. Col. L. M. Rumsey, Inf. Res., President, St. Louis Chapter of the Reserve Officers' Association, introduced the speaker.

Colonel Whelen's address was splendidly received. He discussed small arms practice and concluded with an illustrated lecture of his hunting and exploration experiences in the Canadian Northwest.

This was one of the most successful gatherings held under the auspices of the St. Louis Post. Despite the capacity of the hall which seats 250, 300 members and guests were able to hear the address while some 75 could not be accommodated.

Chicago Post

AT the annual election of officers held by the Chicago Post, Army Ordnance Association, the following officers were elected: President, Lieut. Col. Alex. K. Hamilton; vice-president, Lieut. Col. Wm. R. Wright; directors: E. A. Russell, George E. Scott, G. C. Thorp, Lieut. Col. F. A. Lorenz, Maj. W. H. Damon, Maj. C. E. Heimbrodt, Capt. W. B. Hobbs, and Maj. Francis W. Parker, Jr. At the same time the board of directors announced the reappointment of Maj. W. H. Damon as treasurer of the Post and Maj. M. K. Barroll, Jr., secretary.

Brig. Gen. John J. Carty

THE ranks of American civilian and military engineers suffered an irreparable loss by the death on December 27, 1932, of Brig. Gen. John J. Carty, retired vice-president and chief engineer of the American Telephone and Telegraph Company, whose professional work in peace and war won for him an outstanding place in the field of telegraphic and telephonic communications.

General Carty was director of communications for the American Army in France during the World War where under his direction 282 telephone exchanges and 175 telegraph stations were organized and operated. He expanded this military network by cable under the English Channel so that the American Army in France was entirely independent of all other communications facilities. After the Armistice he was signal officer in charge of communication work of the American Commission to Negotiate Peace. For his military service he was awarded the Distinguished Service Medal and also received the Cross of the Legion of Honor from the French Government.

Acknowledged as a pioneer in the development of electric communication, General Carty included among his achievements the laying of the submarine cable from Key West to Cuba, the development of "wired wireless," the phantom circuit, the load coil, the vacuum tube and other devices. Several years ago General Carty became a member of the War Department Business Council.

Col. R. L. Streeter

MEMBERS of the Army Ordnance Association will regret to learn of the death of their associate, Col. Robert L. Streeter, formerly vice-president of the United States Aluminum Company, who died in Chicago, December 10, 1932. Colonel Streeter had recently opened an office in Pittsburgh for the practice of mechanical engineering, specializing in the fabrication of aluminum and aluminum alloys. Failing health necessitated his removal to Chicago for extended treatment.

Born fifty-two years ago, Colonel Streeter was a graduate of Penn State University, class of 1903. After serving with the Packard Motor Car Company and the Lackawanna Steel Company, he joined in 1910 the faculty of Rensselaer Polytechnic Institute as professor of steam and gas engine design. In 1917 he was commissioned a captain in the Ordnance Department and ordered to the Rock Island Arsenal. He served at that establishment until the termination of the war when he had attained the rank of lieutenant colonel. On October 1, 1919, he was made chief mechanical engineer for the Aluminum Company of America, and in November, 1920, he became vice-president of the United States Aluminum Company and general superintendent of its fabricating plants, which position he held at the time of his resignation in September, 1931.

New Members

THE following have been admitted to membership in the Army Ordnance Association since the last issue of ARMY ORDNANCE: John H. Agnew, Boston, Mass.; Claude L. Allen, Pontiac, Mich.; Alf E. Anderson, Boston, Mass.; J. P. Caporal, San Antonio, Texas; John M. Crowe, Cincinnati, Ohio; Alex Dow, Detroit, Mich.; L. A. Harriman, Princeton, Ind.; Harry R. Marshall, Newton Center, Mass.; J. J. Mayou, Chicago, Ill.; S. T. Moore, Wytheville, Va.; R. A. Nielsen, Stanford University, Calif.; Philip Rhinelander, New York, N. Y.; W. A. Rigsby, Augusta, Ga.; William J. Schnautz, Buffalo, N. Y.; P. L. Spruance, Richmond, Va.; Weller E. Stover, Wilmington, Del.; Sidney O. Svendsen, Seattle, Wash.; E. C. Swain, Waltham, Mass., and S. Grant Young, Salt Lake City, Utah. Messers. Dow and Spruance are new additions to the roster of life members.

Necrology

SINCE publication of the last issue of ARMY ORDNANCE notice has been received of the death of the following members of the Association: Samuel T. Bodine, Philadelphia, Pa.; H. W. Hayward, Newton Center, Mass., and Frank D. Stalnaker, Indianapolis, Ind. To the relatives and friends of these deceased members the Association extends condolences.

Association Membership

OVER 90 per cent of the membership of the Army Ordnance Association consists of executives and engineers of American industry who are cognizant of the importance of industrial preparedness. These gentlemen who, through affiliation with the Association are kept informed of current development of munitions, constitute a large portion of the civilian nucleus upon whom our Government will depend for the manufacture of ordnance in time of emergency. The several classes of membership are:

"By-Laws. 5. The fee for life membership in the Association shall be One Hundred ($100.00) Dollars. The annual dues for membership in the Association shall be, for members, Four ($4.00) Dollars; for student members, Two Dollars and Twenty-five Cents ($2.25); and for group members, One Hundred ($100.00) Dollars, payable in advance. These sums are in addition to whatever dues or assessments may be imposed by the respective local posts in the case of members." Complete information will be sent to prospective members upon application to the Secretary.

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Book Reviews

The March of Democracy. The Rise of the Union. By James Truslow Adams. New York: Charles Scribner's Sons. 1932. $3.50.

IN 1931 Mr. James Truslow Adams published a one-volume history called "The Epic of America" which has gained great and justified popularity in this country. The purpose of that book was to interpret American history and to explain the characteristics of modern America from a study of the past. In contrast with such interpretation, the author has recently completed the first volume of another type of history. The present work is a factual survey of this nation's development up to the Civil War, and will be completed in a second volume to be published in February, 1933.

How nearly does Mr. Adams attain his goal of telling "as accurately and impartially as possible the story of the rise of our nation, touching on as many aspects in as much detail as space permits?"

To a business man, the economic aspect of history will appeal most strongly, and he will have complete sympathy with the economic interpretation of national development. The statesman will readily admit that emphasis should be placed on the political phases of the past. The soldier will want to magnify the influence of the army on the course of history. Mr. Adams readily admits that "history, like human nature is vastly complex. There is no one key—economics, religion, politics or what-not—to an understanding of the whole." In general the artisty of Mr. Adams seizes upon the relevant, and reduces the unimportant to its proper dimensions. In spite of the numerous American histories there is room for this work which is based on a fresh selection from the voluminous records of our past. But has he allowed the pendulum to swing back too far from the old "drum and trumpet" histories?

Isn't there some danger that the influence of our past wars in forming the republic will not be viewed in proper perspective in consequence of the comparatively small space devoted to them? Moreover the lack of any maps in connection with the wars of the Revolution and 1812 is especially noted in a volume that is distinguished by so many excellent and unique illustrations and reprints. It will be interesting to see how the Civil War is treated in the second volume.

With this reservation, this new work of Mr. Adams may be characterized as a judicial, well written, well balanced and adequate study of that part of our history ending just before the outbreak of the Civil War. It is so delightfully readable that American history will certainly become a pleasure for many a reader who has heretofore dozed over the study of our past. It is vivid proof that sound history and literary excellence can be merged.

Simple Aerodynamics and the Airplane. By Col. C. C. Carter. New York: The Ronald Press. 1932. $4.50.

THIS is the fourth revised edition of the text of an important work, the first and second editions of which were prepared in 1924 and 1925, respectively, by Charles N. Monteith, formerly of the Army Air Corps. The third edition was prepared by Colonel Carter in 1929 and the current volume brings the text up to date.

Essentially a textbook for use in teaching cadets at the U. S. Military Academy, fundamental principles are presented in terms which are not highly technical and the book can serve similar important functions in non-military schools where the engineering of heavier-than-air craft is taught.

Moreover, for those of us who are no more familiar with the technique of aircraft and flying than is to be observed by the airline passenger or the witness of military flying maneuvers, there is more than passing interest. This new science bringing to the projectile ranges which other forms of weapons can never approximate has for the ordnance engineer as well as the lay mind a fascinating interest. The treatment of propellers and the text on parasite resistance, for example, contain a wealth of data not heretofore so simply and interestingly assembled.

Colonel Carter gives exhaustive data on such criteria as air foils, stability, dynamic loads, control surfaces and materials and construction. The work of revision has been so thorough that appendices contain descriptions of the autogiro and, of particular appeal to the layman, the complete nomenclature of an airplane. The book is amply illustrated and at the end of each chapter are series of questions for classroom use. For those who are so inclined, the questions can be of material use to readers whose air-mindedness has not had the practical advantage of coming under the tutelage of the author. We congratulate both author and publishers on the excellence of this work.

Gettysburg. The Place, the Battles, the Outcome. By W. C. Storrick. Harrisburg, Pa.: J. Horace McFarland Co.

THE military student has long had available the detailed studies of the Battle of Gettysburg. Now the non-technical reader will find in this little book an account of the battle, accurate in statement, sober in comment, and adequate in explaining the moves of the three days struggle. The author has spent all his life in Gettysburg. He heard Lincoln's famous address there. He has been a member of the Battlefield Commission and Superintendent of Guides. He, therefore, writes with a thorough knowledge of the terrain, and with information gleaned from personal contact with many participants on both sides.

The author explains the strategy that resulted in the battle and undertakes to describe the occurrences on each of the three days engagement. The maps are sufficiently accurate for the purpose of the book, which is also well illustrated with photographs of the battlefield. There are separate chapters in which the activities of the cavalry and artillery are discussed. The anecdotes of the battle add to the liveliness of the description of the military events.

The visitor to the battlefield will find this an indispensable guide to a complete understanding of the most famous battle of the Civil War. Its form particularly adapts it to this purpose. It is also an accurate and interesting description of the battle for the general reader.

The Index to ARMY ORDNANCE, Volume XII, is now available for distribution. It is arranged by subject and author alphabetically and includes title page for binding. Copies of the Index will be furnished without cost upon application to the Editorial Office, ARMY ORDNANCE, 805 Mills Building, Washington, D. C.

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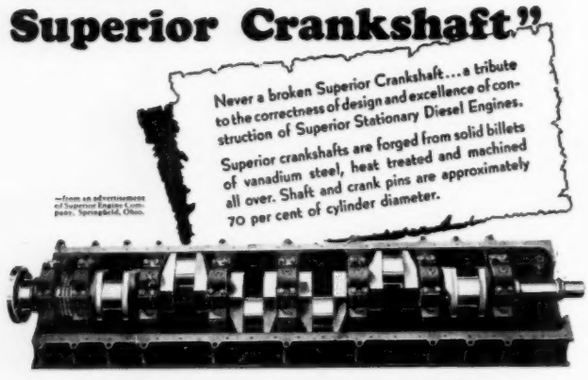
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ARMOR VERSUS BULLETS

(*Continued from page 210*)

custs have defied our most scientific attempts to destroy them.

"It can also be argued that we are overdoing the use of armor, and that lighter, cheaper, and more mobile machines, using nothing but a shield, would be of far better value. Armor of some kind has always been used in war; the Roman soldier had his shield as armor, but he kept it to a reasonable size and weight, and warded off enemy blows from the direction in which they were coming. He did not consider it necessary to have an all-round shield to ward off surprise blows coming from any direction. In the same way, we might equip our fighting vehicles with a shield which they would use to swing round to the required direction and ward off the enemy fire; this would enable us to have larger numbers of lighter and handier fighting vehicles, compared to the number and type available if we insist on all-round protection. Moreover, a shield might be made of heavier armor plate than we could afford to use for covering the whole of a vehicle, and thus provide protection against the lighter types of antitank weapons. . . .

"On land a certain degree of supremacy could be obtained by using more powerfully armored tanks as a surprise, but the gun will easily defeat the armor in the end, when the latter has to be transported cross-country by mechanical means. Owing to the very different conditions on the sea compared with the land, the general policy has been to pit armor against guns, but such a policy would be fatal in the army. It is by the use of speed and mobility and a reasonable use of armor that we shall succeed on the land."

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